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CONTENTS

EDITORIAL:
- Units of Energy . . . 935
- The Advantages of Electric Power in Textile Mills . . . 936
- A Simple Telephotographic Method . . . 937
- A Selenium Photometer . . . 937

The Electric Railways of Buenos Aires . . . 938
Photo-Transmission . . . 942
Electric Power in Textile Factories, by W. B. Woodhouse . . . 943
BOOK REVIEWS . . . 946
Energy Transformations from the Electrical Engineer's Standpoint, by H. M. Hobart . . . 947
The McCall's Ferry Power Project . . . 949
The Raising of Power-Factors and the Regulation of Potential by the Use of Rotary Condensers . . . 949
Electrical Notes from Europe . . . 951
Electrical Notes from Great Britain . . . 952
Maryland Telephone Company Passes into New Hands . . . 954
The Milwaukee Northern Railway . . . 954
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE . . . 958
METHODS OF GETTING NEW BUSINESS . . . 960
Pittsburg Branch, American Institute of Electrical Engineers . . . 963
Public Service Commission to Test Electric Meters in New York State . . . 963
Offer for Western Electric Stock . . . 963
Federal Civil Service Examinations . . . 963
INDUSTRIAL SECTION:
- Allis-Chalmers Lighting Transformers . . . 964
- Bossert Utility Box . . . 965
- New Line of Induction Motors . . . 965
- Trade-Mark . . . 965

Electrical Supplies for the Navy Department . . . 966
New Electrical Supply for Philadelphia . . . 966
Generator Units for a New 1,200-Volt, Direct-Current Railway System . . . 966
CURRENT ELECTRICAL NEWS . . . 967
DIRECTORY OF ELECTRICAL AND ALLIED ENGINEERING AND SCIENTIFIC SOCIETIES . . . 971
RECORD OF ELECTRICAL PATENTS . . . 973

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UNITS OF ENERGY.

Of all branches of engineering the electrical probably deals more strictly with the transformation and transmission of energy than any other, and the electrical engineer is, for this reason, constantly thinking of energy effects and energy losses and the means of controlling and converting energy which will secure the highest efficiency. In these dealings he has come to use the kilowatt-hour almost entirely as his unit, and he has found this so convenient that the practice has extended somewhat into other branches of engineering, particularly the mechanical. This unit is a convenient one for most purposes. The quantity it represents is about one-third more than the horse-power-hour and, in electrical work, it is directly derivable from the factors, such as voltage and current, which enter into it. But when it becomes necessary to pass from the quantities expressed in terms of this unit to other units of energy, such as heat and horse-power, it is necessary to introduce a constant—a somewhat bothersome and generally irritating process. This is particularly true when such conversions are required frequently, as, for example, in designing a power station or in computing the temperature rise of a certain piece of electrical apparatus.

This annoyance is entirely unnecessary, as is shown by Mr. H. M. Hobart on another page of this issue, in an article in which he advocates the general adoption of the kilowatt-hour as the unit of energy and the translation of our tables of physical constants into terms of it. In other words, briefly put, the table of the properties of steam should be put in kilowatt-hours instead of British thermal units or calories, and specific heats of materials should be treated in the same way; engine and boiler performance should also be stated in terms of the same unit, or of the kilowatt instead of the horse-power, when the rate of working is given.

Mr. Hobart's reason for selecting the kilowatt-hour instead of other units of energy is based on several facts. One is the more frequent use of this unit than any other, and another is that it is a metric unit which is employed throughout the world, and which is immediately convertible into, or deducible from, other metric measurements. The convenience of such a system is at once shown by the application of this method to any energy calculation. For example, the temperature rise of a given transformer is at once obtainable if the losses are expressed in kilowatt-hours and the specific heats of the various materials entering into it are given in terms of the same unit. Adding the specific heats together and dividing them into the losses gives at once the temperature rise in an hour. If the loss of

heat due to the radiation be expressed in the same terms, it is merely necessary to deduct this from the sum of the losses without complicating the calculation appreciably. In the same way, by expressing the heat value of the coal in kilowatt-hours per pound, it is a very simple matter to carry a computation through from the coal pile to the consumer's apparatus, finding the efficiency and losses of every step. The nuisance of having to introduce various constants and to change from one system used to another, and the accompanying risk of errors which this introduces, are thus avoided.

The term "kilowatt-hour" is, in one sense, unfortunate, because in it we express a rate which itself involves the element of time, and then we cancel the time by multiplying by the hour. The reason for this lies in the fact that our system of dividing time is not decimal, and hence the relation between the fundamental unit and the unit in practical use is not simple. The former is the joule, or watt-second. The practical unit of power, the kilowatt, if used for one second, would give a kilojoule, and the ratio between the latter unit and the kilowatt-hour is, of course, the ratio between the second and the hour, which is somewhat inconvenient for practical purposes. For this reason the term "kilowatt-hour" is of practical value, in spite of the fact that it really amounts to a second unit of energy.

In addition to pointing out the ease with which energy calculations may be carried out when all such quantities are expressed in kilowatt-hours, Mr. Hobart has gone to the trouble of reducing a number of important tables, which are in constant use, to this unit, thus furnishing the engineer with the very information which he needs in order to apply the method proposed. Every one who examines this suggestion and puts it to actual test will at once realize the great convenience and saving of time which may be made in this way; and electrical engineers in particular who have, to some extent at least, been relieved of the annoyance of using a system involving a large number of transformation constants will welcome this method of relieving their labors when it would otherwise be necessary for them to employ non-electrical units.

In the concluding part of his paper Mr. Hobart says that the term "kilowatt-hour" is a little awkward, and suggests as a name, "Kelvin" or "Kapp." The suggestion is a good one, in spite of the fact that, as shown above, we already have a unit of electrical energy, the joule, though the latter is, unfortunately, not altogether convenient on account of our horological system. The adaptation of either of these terms would be properly honoring a man closely identified with the early developments of electrical engineering. It seems rather strange that Lord Kelvin's name has not already been honored in this way, since he is affectionately called "the father of electrical engineering." Mr. Hobart, however, is rather inclined toward "Kapp," on account of its brevity. Certainly, this term would be most appropriate, since Gisbert Kapp has done much to advance the theory and the art of designing electrical machinery. Either term, however, will require the sanction of general use or the approval of some of the international organizations. If Mr. Hobart's proposed method should be adopted, a short, distinctive term, such as "Kapp," for the unit of power would be almost necessary.

THE ADVANTAGES OF ELECTRIC POWER IN TEXTILE MILLS.

The advantages that may be secured by adopting the electric drive in textile mills have, at various times, been stated in a general way. At first such transformations as are involved in the change from mechanical driving to electric were made with the anticipation of reducing the cost of power production; but in this field, as in many others where the electric system has wrought great improvements, the most important gains have not been made in this particular way. In fact, allowing for the cost of the installation and other factors of expense, the actual price of the power generated in the power-house itself may be more than that under the old system. The efficiency of the electrical system of transmission is, however, well recognized, even though the inefficiencies of the older mechanical systems are not so well appreciated; and even though the cost per unit of power generated in the engine room should be a little greater, at the point of utilization it should be less, and it is the reduction in cost up to this point which is usually expected to offset the cost of the transformation.

In many cases the full gains which may be secured by such a change of motive power are not fully appreciated before such change is put into effect. It is doubtless true that, due to the difficulties of determining all the losses by a mechanical guide, the efficiency of that system is considerably less than is believed. The steam engineer may think that he has an efficiency of transmission of seventy-five per cent when actually it is only fifty, or perhaps even less, and ignorance in this matter would, of course, influence him against the electrical system because he would not only think that such a change would not be as beneficial as it actually would be, but he would also believe that more power is required at the various machines than is actually taken. For this reason he would figure on a larger electrical installation than would be necessary, thus making the cost of the latter greater than it really should be. Such questions can be settled only by actual trial or by a satisfactory test of a typical mill, carried out with the intention of determining the efficiency of transmission at every point. When this is known, then, and only then, can an electrical system for doing the work be figured upon with certainty. It is, of course, not difficult to put in a plant which will do the work, but it is almost as bad to install much too large a plant—thus saddling the mill with unnecessary expense—as it is to put in one too small, so that it is continually giving trouble due to overloading.

An interesting discussion of this question was given before one of the English engineering societies by Mr. W. D. Woodhouse, whose paper is published elsewhere in this issue. This

paper is valuable because the actual results secured through the installation of an electric system are given in it. In this paper Mr. Woodhouse not only points out the advantages which have been enumerated above, but he shows also that there are other gains which may be made, and which are often of much greater importance than the most apparent ones, giving the actual figures for some of these factors. For example, it has often been contended that the individual motor, or even a motor driving a group of machines, gives a more uniform speed than a countershaft. For this reason not only is the grade of material turned out better, but the machine may be run at a higher speed on account of this uniformity, and hence its production is increased. In one of his curves Mr. Woodhouse compares the uniformity of rotation of the motor drive and the steam engine. Here there is some difference, but the variation of speed at the machines is shown to be considerably greater than that at the engine, so that, for steadiness of drive, the countershaft, in this particular case at least, could not be compared with the electric motor. In this case the speed variation at the engine was three per cent, while at the loom it was twenty per cent. In the case of a mule driven by a countershaft it was found that the average speed was fourteen per cent less than that of a corresponding machine driven by an electric motor geared for the same speed, due simply to the variation in the drive. Not only did the electric motor increase the speed by decreasing the variation, but, on account of its steadiness, it was allowable to gear the machine up to a higher speed. In other words, the increase in speed and output was twofold.

To make the comparison definite Mr. Woodhouse compares two similar mills—one driven mechanically and the other electrically. Assuming that the electrically driven mill can be run at a ten-per-cent greater speed than the other, he finds that the annual profit from the mechanical drive would be about $50,000, while that from the electrical drive would be $62,250, an extra profit of $12,250, which is equivalent to twenty-five per cent of the profit of the mechanically driven mill. It is such variations as these that will have the greatest influence in introducing the electric drive. A mill owner may be content to go along under the old plan, even though he believes that he could make a decided saving by a change of motive power, because he does not wish to tie up additional capital. If, however, he realizes that the output of his factory can be increased, as indicated by Mr. Woodhouse, he can properly compare the outlay required for the new power system with the cost of making a corresponding increase in the equipment of his old mill. This puts the matter in a somewhat different light, and will probably, in many cases, lead to the transformation. These results are only in accord with those of similar transformations in other branches of industry.

A SIMPLE TELEPHOTOGRAPHIC METHOD.

An ingenious system of transmitting pictures electrically has been devised by M. Edouard Belin. It is described briefly elsewhere in this issue. The transmitter utilizes the relief image produced in a carbon print, the difference in the thickness of the gelatine picture causing, by means of a delicate rheostat and a stylus, corresponding variations in the transmitting current. This plan is not altogether new.

The receiver, however, is novel and very simple. The current passes through an oscillograph, or a short period galvanometer, and causes corresponding deflections of a beam of light reflected from the mirror of the instrument. By means of a lens, this beam is always focussed on a small opening in a diaphragm close up to the sensitive receiving paper. Between the lens and the diaphragm is placed a photometric wedge, through which the beam of light passes, and thus suffers more or less absorption, according to the portion of the wedge through which it is sent, and which is, of course, regulated by the intensity of the transmitting current to correspond to the picture at the transmitting end. By turning the wedge about either a positive or negative record may be secured.

With such a simple method, the driving of the transmitting and receiving mechanisms in synchronism probably becomes the most troublesome part of the problem. For this purpose alternating currents are usually resorted to, and the method devised by Rowland for his page-printing telegraph is most frequently adopted. Each mechanism is driven from a local source of power, so that the regulating current sent over the line need represent only the power required to control the variations of the speed of the receiving device so as to correspond to those of the transmitter.

A SELENIUM PHOTOMETER.

There have been many attempts to devise a photometer which would substitute the sensitiveness of a selenium cell for the eye in making comparisons, but the difficulties have been serious. An ingenious attempt to overcome these is embodied in an instrument which is said to be on the market in Germany and which is described in the foreign technical journals. One of the most troublesome characteristics of the selenium cell is its sluggishness, or hysteresis effect; the change in resistance brought about by a change in illumination is not instantaneous, but lags somewhat behind the variations in the light. This, it is said, has been overcome in the new instrument by using but a single cell, which is oscillated so that it passes alternately into fields illuminated by the two sources of light being compared. When the illuminations are equal, there will be no variation in the resistance of the cell, which can be shown by a battery and galvanometer. In this case the sluggishness of the cell has no effect.

It would seem that any bolometer might be used in the same way, care, of course, being taken to cut off all the non-visible radiations. In both cases, however, what are being compared are not physiological, but physical, effects, which are not the same thing. There is yet to be found a physical phenomenon, due to radiant energy, which is strictly comparable with the action of the eye. Hence, all attempts to substitute the measurable indications of a physical instrument in place of the judgment of the eye, while often useful, are always limited. These methods can not take the place of visual methods.

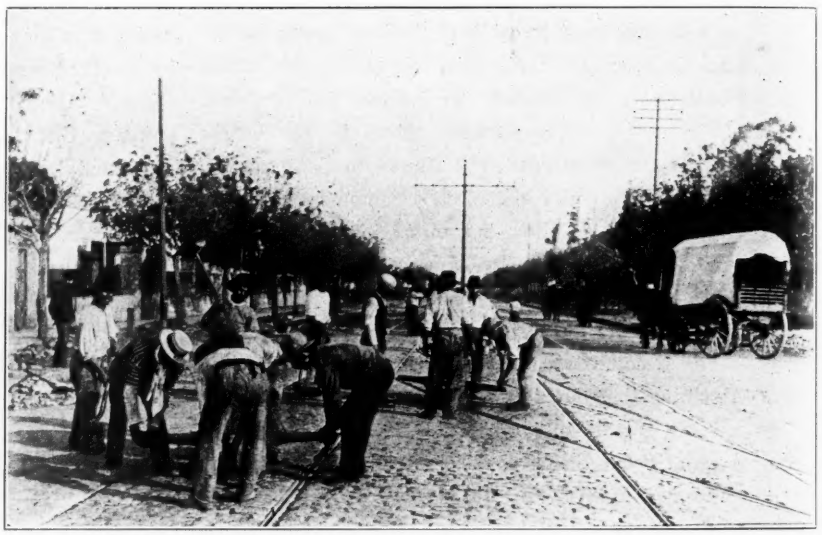
The Electric Railways of Buenos Aires.

BUENOS AIRES, which was founded in 1535, had in the year 1870 a population of some 180,000 inhabitants. To-day, according to official statistics, the population within the city limits exceeds 1,100,000. The rate of increase, due to natural causes and to immigration, amounts to doubling every thirteen years. In a period of five years the increase is equivalent to the whole of the population of a large capital like Lima.

After Paris, Buenos Aires is the largest Latin capital of the world and, by reason of its many fine buildings, its splendid avenues and parks and the organization of its public services, is often called the "Paris of South America."

Like most cities of relatively recent creation in the new hemisphere, Buenos Aires has had the advantage over older historical European cities, inasmuch as it has benefited, free of all experimental costs, by the latest improved inventions connected with public works. At the same time, however, it must be recognized that the citizens of the Argentine capital have been very much alive to the possibilities of modern engineering and modern business methods, and the marvelous progress of the city is due to their foresight and energy.

Among the public works of note may be mentioned the port, with its four large docks for transatlantic steamers; thoroughly up-to-date drainage and water-supply systems, and extensive railway networks connecting the capital with the fertile plains of Argentine and with the seashore and interconnecting the eastern part of Argentine by intercontinental routes with Chile, Bolivia and Paraguay. In addition, there is a large development in electric lighting and electric railway undertakings. In fact, one of the greatest difficulties has been the meeting of the constantly increasing requirements of the rapidly growing country and capital for all kinds of public services. For instance, the port works, which were built but a few years ago, and were considered at that time amply large for many years to come, have been so congested of late that many hundreds of thousands of dollars have been lost to shippers and to the trade in general. However, at the present time a new scheme for considerable enlargement, involving an outlay of $25,000,000, is being actively pushed forward. Furthermore, the building of new approaches for the railways and of new stations, the paving of considerable extensions of new streets, the supply of drainage and water for large new areas, the increase of electric lighting and the development of the telephone systems are all now in full swing. The transportation of the populace within the city, and from the city to the suburbs, is also meeting with due recognition. That the traffic within the city itself is of great magnitude is proved by the returns of last year, which show a movement of over 200,000,000 passengers by the tramways alone. This great movement is explained by the considerable area covered by the city, which is equivalent to not less than two-thirds of that of London, and consequently greater than that of large cities like Paris, Berlin, Glasgow, Hamburg, Genoa and Vienna.



TRACK AND OVERHEAD CONSTRUCTION OF THE BUENOS AIRES LACROZE TRAMWAYS.

Due to this great extension, to the warm climate, and to the fact that the population prefers to ride even for very short distances, the needs of adequate transportation facilities have been particularly great. Even some years ago the horse-tramway system was very considerably developed, amounting to some 280 miles. Owing to the disposition of the streets, which are on the American chessboard system, and to their narrowness, the tramway lines have been distributed all over the town in such a manner that practically not a single important street is without its line. In order to avoid congestion, the tramway traffic as a rule moves in one direction only. Every line, therefore, uses certain streets on its way out and different streets on the return journey.

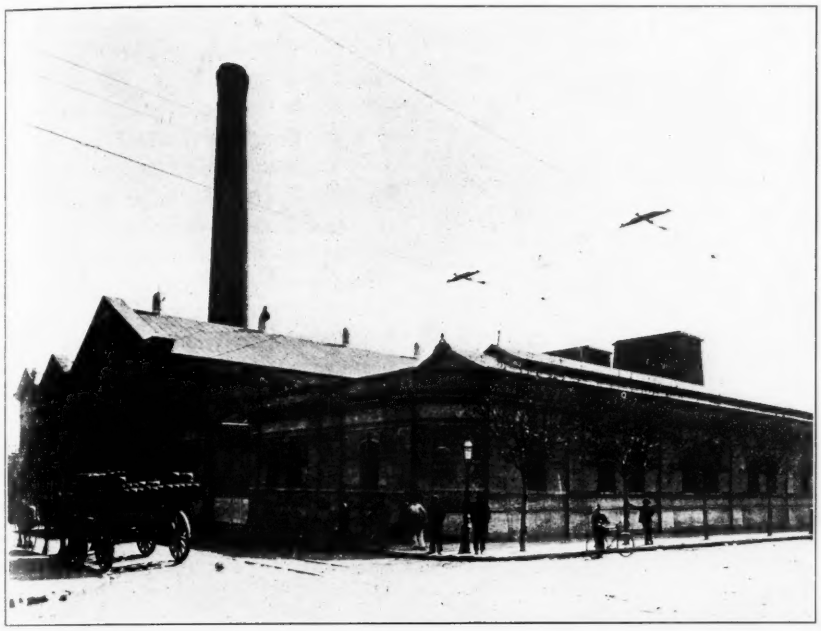
In the early nineties it was evident to the street railway's owners that horse lines were no longer capable of meeting the demands made upon them, and accordingly the first section of electric railway was laid in 1897. Since that time practically all of the lines have been converted by various companies, mostly formed by English enterprise. The increased facilities afforded by electrification have, however, as usual, not diminished but increased the congestion. The municipality, in order to ameliorate the conditions under which transportation is carried on, has decided to construct a vast system of diagonal avenues and of street widenings, for the planning of which the services of the eminent French architect, Bouvard, have been requisitioned. This scheme, when carried out, will cost many millions of dollars and will change the whole aspect of the city.

Among the various street railway systems of Buenos Aires one of the most interesting is that of the Buenos Aires Lacroze Tramway Company, the only native Argentine street railway company in the city, and the only line running a high-speed suburban service on American lines, with private right of way and cars equipped for a maximum speed of fifty miles per hour.

The Tramway Rural was formed in the year 1884 by one of the pioneers of street railway traction in Buenos Aires, Federico Lacroze. The first line which he built ran from the Plaza de Mayo to the Plaza Il de Setiembre, which line he afterward sold to the Anglo-Argentine company, and has been the nucleus of

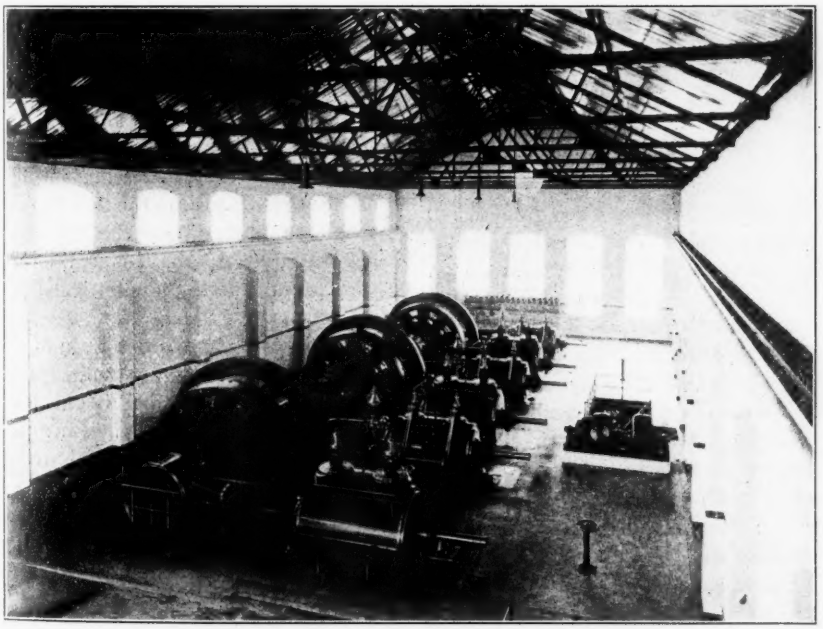
the very large system now operated by that company.

With remarkable activity Mr. Lacroze extended his system into the system of



The Power-House of the Buenos Aires Lacroze Tramways.

street railways, until recently operating under the name of the "Rural Tramways," and, in addition, extended his lines many miles into the country, at a time when the other companies did not realize the importance of possessing adequate suburban communication.



Generating Equipment in the Power-House of the Buenos Aires Lacroze Tramways.

The whole undertaking grew to a point where it became necessary to form two different systems, viz., "The City Tramway Lines," now known under the name of the "Buenos Aires Lacroze Tramways," and a steam railway line, extending from Chacarita Station, in Buenos Aires, to Salto and to Zarate, a total length of 135 miles. This steam line, which long was known as the "Tramway Rural à Vapor," has recently been organized into a new company called "Ferro Carril Central de Buenos Aires, Limitada."

One interesting point in connection with the original franchise was that this was granted to the concessionaire under the obligation of the exclusive use of horse traction. The reason given by the authorities for this stipulation was that it was necessary to develop the national industry of the country, which at that time depended almost entirely upon horse breeding.

The original railway was extended by degrees, under the old concession, for a distance of upward of 100 miles into the country, and there can be no doubt that this line holds the record for long-distance tramway service by horse traction, and, in addition, the Rural Tramways can boast of having been the first street railway to run a sleeping car over its lines.

At a later date the authorities recognized that, for the purpose of giving an efficient service, it was necessary to grant permission to use mechanical traction, and for this purpose steam locomotives were employed.

The considerable development of the business of the Rural Tramways in the hands of Federico Lacroze became, at his death, still more important in those of his active and energetic sons.

Their first step was to enter into a contract, in the year 1905, with J. G. White & Company for the reconstruction and electrification of the old city lines, under the name of the "Buenos Aires Lacroze Tramways." Being laid in the new portions of the city, the streets are wide enough to accommodate a double track.

The work was commenced in March, 1906, and before the end of that year the new power-house, with a capacity of 2,250 kilowatts, was in running order — an achievement which, considering the labor troubles and the port congestion, may well be considered a record for rapid construction.

Part of the lines was opened formally to public traffic on March 10, 1907, and since that time the traffic receipts have increased beyond all expectation.

The original lines consisted of twenty-five miles of track, owned by the company, and 6.2 miles held jointly with other companies and on lease. J. G. White & Company are now engaged in extending these lines a further twenty-five miles, the franchise for which was granted by the Buenos Aires municipality in December, 1905, and for the purpose of serving these new lines another 750-

kilowatt generating set is being added to the station.

All the lines are laid to a gauge of four feet eight and one-half inches. The rails, manufactured by the German and Belgium mills, weigh eighty-seven pounds per yard. The first shipments were forty-five feet in length, but on account of shipping difficulties later shipments were made in forty-foot lengths.

The rails are laid on concrete stringers. The depth of the stringer is six inches and the width sixteen inches. The greater part of the paving has been executed with granite blocks, the blocks being rammed by an implement operated by four men.

The rails are bonded by two concealed bonds, No. 0000 B. & S. gauge. The gradients offer no difficulties, since the track is practically all laid on the level. The radius of the sharpest curve is forty-five feet.

The overhead equipment consists of side poles with span-wire construction, centre poles, side-pole construction with bracket arms and a few rosettes. The poles are made to the British standard specification, of steel, thirty feet in length, in three sizes. The trolley wire is No. 00 B. & S. gauge, copper, with a height of twenty feet six inches from the ground.

The power-house is situated at the corner of Medrano and Cuyo, the buildings being of massive brick construction with an exterior plastering usual to the country. The buildings comprise an engine room, 185 by fifty-five feet; a boiler house, 130 by thirty-one feet, and a coal storage of the same size, representing a total area of 19,000 square feet, and with room for considerable extensions. A massive brick chimney has been built, its height being 155 feet.

In the engine room are installed three 1,100-horse-power horizontal cross-compound engines by Carels Frères, Belgium, constructed after the Sulzer patent; these each drive direct a 750-kilowatt, compound-wound, direct-current generator by the General Electric Company, New York, giving 550 volts at 115 revolutions a minute. The consumption of the engines averages twenty-two pounds of steam per kilowatt-hour with a load-factor approximately forty per cent. Each engine has its own condenser of the "Contraflo" type. The air-pumps are of the Edwards type, independently driven by steam engines. Worthington centrifugals are used for circulating pumps, each being capable of dealing with 1,000 gallons per minute, and are driven direct by Brown-Boveri motors.

The switchboard is located at the end of the engine room, facing Cuyo, and is of the railway type, by the British Westinghouse Company, and at the present time consists of fourteen panels, which comprise three generator, three negative-booster, six feeder, a metering and a lighting panel, the panels being of marble, and equipped with all the necessary instruments for a safe and rapid handling of a large traction load. At the present time one sixty-kilowatt negative booster is installed, and a twenty-five-ton crane traverses the engine room.

The water for condensing purposes is cooled by two natural-draft cooling towers, which are of wood, each tower being capable of cooling 66,000 gallons per hour.

In the boiler house are installed, with room for extensions, five marine-type boilers by Babcock & Wilcox. These are fitted with their well-known superheaters, having a heating surface of 630 square feet. Each boiler is capable of evaporating 12,000 pounds of water an hour, the grate area and heating surface being forty-nine square feet and 2,480 square feet respectively.

The three feed-pumps installed are of the Worthington duplex type. A Wheeler feed-water heater, capable of utilizing all the steam from the auxiliary plant, is installed, and there is also a Paterson condensation-water purifier and grease eliminator.

In the coal store an electrically operated overhead transporter with a grab bucket has been fitted, and in the power-house yard there is a twenty-ton weigh-bridge for coal-weighing purposes.

The water supply is taken from a well on the premises, by a treble-barreled deep-well pump, electrically driven. A supplementary supply can also be taken from the city supply.

The feeders have been supplied by Callender's Cable and Construction Company, Limited, and are paper-insulated, lead-covered, and are drawn into Sykes' patent stoneware conduits.

There are three carsheds, one being at Medrano alongside the power-house; the other two are respectively at Chacarita and Palermo.

The rolling stock for city purposes will consist of 140 cars of the semi-convertible type, the cars being supplied by the J. G. Brill Company. Their construction allows the car to be completely shut in during bad weather, while at other times it is practically an open car. There is seating accommodation for thirty-two persons; the seats are upholstered in cane. The tops of the windows on each side of the car are made in accordance with the Brill patent. The glass of the windows is set in rubber. The car doors are of the mutually operating double sliding type. The platform at each end of the car can be entirely closed if desired; it is in the form of a vestibule, having three drop windows in front and two-leaf folding doors on either side, as well as a sliding metal gate. The roof is of the monitor-deck pattern. Two electric fans are also fitted and the cars are well lighted. The wood employed inside for the doors, linings and moldings is mahogany, while the ceiling is decorated with three-ply birch veneer. The cars are tastefully painted cream and green outside with trimmings of solid bronze.

The electrical equipment comprises two forty-horse-power motors supplied by the British Westinghouse Company, capable of maintaining a speed of fifteen miles per hour.

In addition to the city cars there will be, at first, ten interurban cars, the only difference being that these are larger, seating forty-four people, and that the electric equipment comprises four fifty-horse-power motors. With these it will be possible to maintain a speed of forty miles per hour. These cars will operate on the city lines, passing on to the steam line at Chacarita and running through Lynch to the important suburb of San Martin.

Electric locomotives will also be used in connection with the heavy-goods department—a large and increasing business. Dick, Kerr & Company, Limited, are supplying the locomotives, the type used being the central cab, mounted on two four-wheeled trucks, the electrical equipment comprising four fifty-horse-power motors, capable of hauling a train of fifty tons at twenty miles per hour. These locomotives will haul the freight trains of the F. C. C. B. A. and the Entre Rios Railway from Chacarita to the freight station at Once and to the market.

C. E. d'Ornellas acted as superintendent in charge of the above work for J. G. White & Company, Limited.

FERRO CARRIL CENTRAL DE BUENOS AIRES.

The Ferro Carril Central de Buenos Aires is a railway of four-foot-eight-and-one-half-inch gauge, extending westward and northwestward in the province of Buenos Aires, from Chacarita Station, in the city of Buenos Aires, to the town of

Salto, a distance of 108 miles, with a branch twenty-seven miles long to Zarate, a town on the Paraná river, and a branch of three kilometres from Lynch to the suburb of San Martin. It traverses one of the most fertile districts in the Argentine.

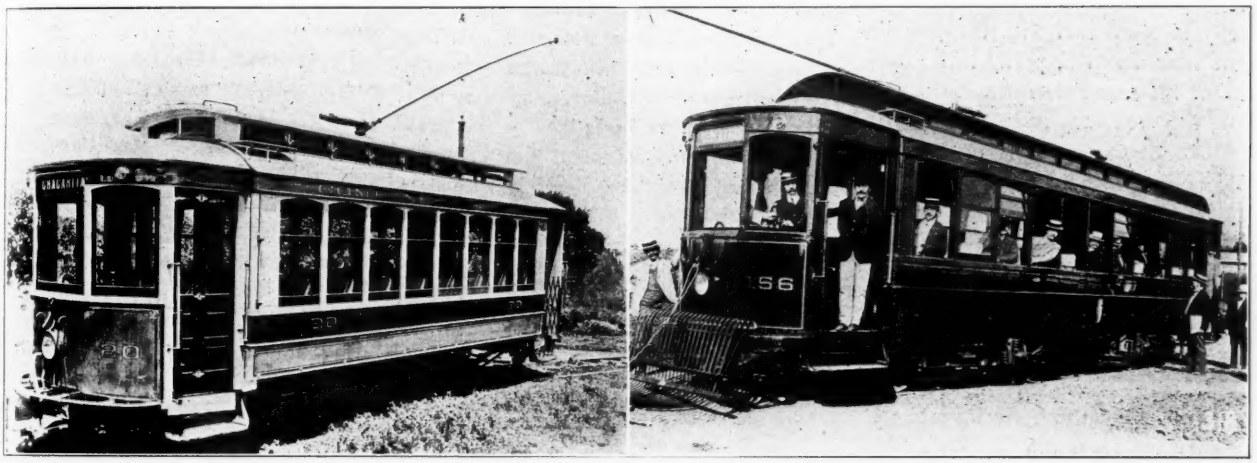
The history of the railway is believed to be quite unique, in that it was constructed as an extension of an urban horse tramway from the surplus earnings of the latter, and was operated as a horse tramway for goods and passengers for a considerable distance in a then thinly settled country. In 1884 Don Federico Lacroze whose horse tramway was the pioneer among the street railways of Buenos Aires, and who already owned at that time an extensive system in the city, obtained a concession to build the "Rural Tramways," to start from Chacarita, then the most westerly point on his lines. Buenos Aires province is one of those regions where it is cheaper to build a railway than a good road. Señor Lacroze saw the opportunity for supplying transportation much cheaper and much more rapid than then existed, to a large, fertile, and rapidly developing agricultural zone.

Construction proceeded as fast as earnings became available for that purpose. From 1885 to 1892 sixty miles of main line, the San Martin branch of 1.85 miles and the Zarate branch of twenty-seven miles, were built, a total of about eighty-nine miles. From 1892 to 1895 the main line was extended to 82.5 miles, and by 1897 the present system of 137 miles was entirely in operation. The early type of construction was necessarily very economical; the rails weighed thirty pounds to the yard; the sleepers were creosoted yellow pine six feet long, and the bridges were supported by wooden stringers. Earthwork was avoided as much as possible, the track being laid practically upon the ground.

It became evident as early as 1891 that it would be necessary to introduce steam traction in order to cope with the traffic. Accordingly, eight sixteen-ton saddle-tank engines were bought from the H. K. Porter Company, Pittsburg, Pa., and bridges were strengthened to receive them. With the earnings of these eight locomotives, supplemented in 1896 by three eighteen-ton passenger locomotives, the railway was rapidly developed, gradients were reduced, rolling stock purchased, a handsome new passenger station built at Chacarita (the Buenos Aires terminus); the large and modern fireproof freight station built near the Plaza Once in the heart of the city of Buenos Aires, thirty-one miles of line relaid with fifty-pound rails, and the twenty-nine-mile extension from Salto to Rojas begun.

The Ferro Carril Central de Buenos Aires is at present in transition from a light railway to a standard heavy railway. This was appropriately marked by its being transferred, in July, 1906, by Lacroze Brothers & Company to a new company, the Ferro Carril Central de Buenos Aires, the old name of Tramway Rural à Vapor disappearing.

This period of transition, an inevitable phase in the development of so highly favorable an enterprise, may be said to have been occasioned by the agreement with the Entre Rios Railway. The latter, founded as a provincial government railway in 1883, now an English company, operating some 480 miles of four-foot-eight-and-one-half-inch-gauge line, has always been a purely local enterprise, being segregated from the city of Buenos Aires, as well as from the rapidly developing provinces of Buenos Aires and Santa Fé by the immense Paraná river, which interposes not only its own enormous width, but also a belt of swampy delta land, thirty-five to forty miles wide, as a barrier along the entire western and southwestern sides of the province of Entre Rios. Similarly, the northern connections of the Entre Rios railway, the East Argentine Railway (ninety-nine miles) and the North East Argentine Railway (411 miles), all of the same standard gauge, are entirely separated from the rich central provinces of the Republic.



TWO TYPES OF CARS OPERATED BY THE BUENOS AIRES LACROZE TRAMWAYS. CONVERTIBLE CAR FOR CITY USE ON LEFT; INTERURBAN CAR ON RIGHT.

An extension is also under construction from Santo Tomé, the extreme northeastern point of the Northeast Argentine, northward to Posadas, where, by transfer across the Alto Paraná to Villa Encarnacion, it will connect with the 250 miles of the Paraguay Central Railway, also of the same four-foot-eight-and-one-half-inch gauge. Thus there was a system of railways, present and prospective, of about 1,400 miles, awaiting an entrance into the province and city of Buenos Aires. Under these circumstances the Entre Rios Railway made a contract with the Ferro Carril Central de Buenos Aires, by which the former will deliver its trains to the Ferro Carril Central de Buenos Aires at Zarate, whence the latter will haul them to Buenos Aires.

Expensive works have been undertaken for carrying out this programme and are

now well under way. The Entre Rios Railway is extending its lines to Ibicui, a point on the Paraná delta opposite Zarate. There it is building a port and ferry slip, and at Zarate it is building another ferry slip; between these points will ply a large steel transfer ferry-boat, with a capacity of about thirty freight cars.

The ferry-boat for this service was built in Scotland, and proceeded to the Argentine under its own steam, arriving in May. From the ferry-boat at Zarate the Entre Rios Railway is building a connecting line up to the top of the bluff, where it joins the Ferro Carril Central de Buenos Aires. The latter is reconstructing its entire permanent way between Buenos Aires and Zarate, 62.5 miles, using new hardwood sleepers of full size, closely spaced, and seventy-pound rails.

Partly in connection with this general plan of reconstruction, partly as an outgrowth of the recent electrification of the Lacroze City Tramways, the Ferro Carril Central de Buenos Aires is reconstructing its short branch to the large suburb of San Martin, and is equipping the entire line from San Martin to Chacarita terminal (about seven miles of double track) for a high-speed service, which will be operated by the street railway company. By a contract with the Lacroze Tramways Company, dated March 29, 1906, running powers were granted over the lines of the latter company from the Chacarita Station to the freight station at Once, and to the Mercado de Abasto Proveedor, the Covent Garden of Buenos Aires. The engineering and construction work entrusted to J. G. White & Company, Limited, in connection with this railway, consists of about 100 miles of main line laid with seventy-pound Vignole rail on *quebracho* sleepers, and about sixteen miles of sidings and yard tracks with lighter rails, also the necessary waiting and goods sheds and stations to be erected. The longest bridge is 194 feet, in three spans—two of thirty-two feet and one of 130 feet. The Lynch repair shops, situated at Lynch, about midway between Chacarita and San Martin, are being entirely remodeled and fitted with up-to-date machinery. They will consist mainly of a machine and erecting shop, a smithy, a foundry and a carpentry and paint shop. Complete buildings for general stores will be erected, as well as the necessary storage accommodation for locomotives and rolling stock, distributing yards, etc.

The Ferro Carril Central de Buenos Aires has secured from the National Congress a concession for a further extension from Rojas northwestward to Villa Maria, about 185 miles, and a further application has been made for a concession to build a small port at Zarate.

Photo-Transmission.

The following abstract of an article in a recent issue of the *British Journal of Photography*, describing M. Edouard Belin's method of transmitting pictures electrically, which has been exhibited at the Société Française de la Photographie, Paris, is taken from the *Electrician*, London:

"M. Belin's system, which he has termed 'telestereography,' is entirely different from that of Professor Korn's, and has the advantages that the image received is of precisely the same dimensions as that transmitted, and that either a positive or negative image can be formed at the receiver. The essential point lies in the use of a carbon print as the original transmitted, such a print being, of course, a relief in which the contours are proportional to the intensities of the image. This print is wound on the cylinder of the transmitter. In perfect synchronism with this revolves the cylinder of the receiver, the synchronism being effected by the use of an alternating current in the same manner as adopted by Professor Korn. As the cylinder of the transmitter revolves a small point or stylus in contact with it moves along the axis which is geared on to the cylinder or drum. The conditions chosen are such that the print advances lineally one millimetre for six turns of the cylinder, which causes detail down to one-sixth millimetre to be faithfully reproduced. The movements of the point or stylus are transmitted by an arm to a small sliding contact or roulette, working on a minute rheostat. This rheostat consists of twenty very small plates of copper separated by layers of mica and each branching off to a resistance coil.[1] There are thus twenty variations of the intensity of the current possible. At the commencement, before the alteration introduced by the cylinder, there is simply a large resistance of 4,000 ohms; the movement of the transmitting cylinder and the stylus that detail is preserved to one-sixth millimetre according to the contours of the carbon image, and hence, in proportion to the values of light and shade. It will be seen that such difficulties as Korn's method has to meet in the 'chemical sluggishness of selenium,' are entirely avoided in that of M. Belin, which depends on purely physical action. Nor is it a small advantage that the carbon print is of great permanence and durability.

"The variations in the current of the circuit, proportinal as they are to the intensities of the image, are registered by an oscillograph.

"An aplanatic lens throws an image of the reflected ray from a mirror on to a small hole, this hole being one-sixth millimetre in diameter. Behind this minute hole revolves the synchronized receiving cylinder, on which is a photo-sensitive surface. The hole is so near the film as practically to be in contact with it, so that any diffusion of light is avoided. In other words, an image of the hole is continuously printed on the film, and this means that detail is preserved to one-sixth millimetre. Under these conditions there would still be no variation of the light intensity. The way this is effected—that is, the method by which the deviations of the galvanometer are converted into light intensities—is ingenious. Behind the lens is a scale of tones—*i.e.*, of densities (in the sense of Hurter and Driffield), increasing from bare glass to a certain value; in fact, an optical wedge. Various ways of producing this optical wedge may be employed: at present M. Belin uses a photographic plate specially exposed. The scale of densities increases in proportion to the mirror deflections—*i.e.*, to the intensities of the current—so that the hole is illuminated by light varying in intensity with the intensities of the original image. The density scale is mounted on a revolving axis, so that, according to the direction of increase of density, relative to the mirror deflections, a positive or negative image can be obtained at will on the receiving film. Again if, instead of a scale of tones corresponding to those of the original, one of harder or softer gradation be substituted, the image may be obtained reduced or strengthened in intensity."

The inventor claims that in transmission of detail his apparatus is superior to that of Professor Korn. In two or three weeks, with the promised aid of the state telegraph lines, he hopes to give a public demonstration of its capabilities over long distances. At present the transmission of a nine-centimetre by twelve-centimetre image occupies about thirty minutes.

[1] M. Belin explained that he had chosen a range of 1-20 as representing the possible range of contrast in photo-mechanical processes.

ELECTRIC POWER IN TEXTILE FACTORIES.[1]

BY W. B. WOODHOUSE.

In all parts of the world where textile manufacture is carried on there has been, in the last few years, a rapid spread of the use of electric power for mill driving. Mills and their machinery have, in the past, been designed to meet the conditions imposed by the mechanical drive; that is to say, the rooms and floors have been so placed that a main drive from the engine to each room could be effected with economy and simplicity, and the machines themselves have been designed to be grouped for driving from line shafts. The driving shafts of spinning frames have been run at low speed compared to that of the spindles, because of the engine speed being low, and the increase in speed from engine to spindle has been performed in steps by the intervention of belts and gearing. The electrical motor, however, is a high-speed machine, and its first cost per horse-power is lessened as the speed is increased. Textile machinery, then, is likely to undergo a change of design in the direction of an increased speed of the driving shaft, which change of speed should, in spinning machinery, result as an improvement. The general advantages of electrical driving are well known, and the subject is too wide to be treated as a whole in the extent of this paper. It is proposed to consider only the following special points:

(1) Nature of the textile load, as affecting the method of driving.

(2) Advantages of the individual drive.

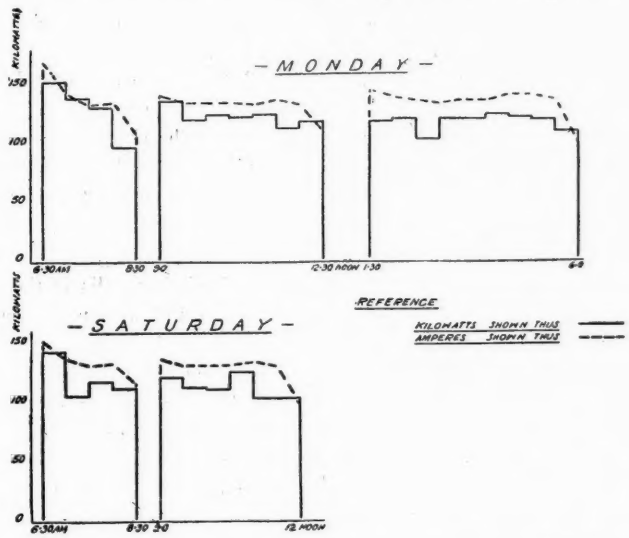


FIG. 1.—TYPICAL CURVES SHOWING VARIATION IN LOAD ON TEXTILE MILL EQUIPMENT, OCTOBER 10, 1907.

(3) Economical use of capital.

(4) Effect of speed on output.

(5) Public supply *versus* private plant.

Nature of the Textile Load—In considering this matter we are first met with the point that a very large percentage of textile machines is required to be run at a constant speed, and it is for this reason that the most suitable type of motor is the alternating-current induction motor. This motor has other advantages over the direct-current motor, simplicity and lower first cost being the greatest. The adoption of direct current, except in special cases, is to be strongly deprecated.

In dealing with the estimation of the power required to drive textile machinery electrically, and with the annual running cost, the engineer has met with considerable difficulty, owing to the practical difficulty which the mill-owner had in estimating his power other than as indicated horse-power. The variation of the power required by any machine in its operation can only be observed when it is electrically driven, and therefore many false estimates of the number of kilowatt-hours which would be consumed have been made. The power costs in a mechanically driven mill are calculated on the basis of the costs of an indicated horse-power-hour, and the load has been assumed to be a steady one, or nearly so. This has led in many cases to a serious overestimation of the cost of the electric drive. The load on textile mills is in no case absolutely steady, and in the case of looms and mules is of an extremely variable nature; moreover, the power taken to drive the machine varies throughout the day, and according to the weather. The accompanying curves exemplify this. Fig. 1 shows the variation of the total power required to drive a mill throughout one day.

Coming to the individual machines, records have been taken electrically of the power required to drive them, and it may be noted here that the taking of such records is a matter of extreme simplicity with the electrical drive; continuous daily records can be taken automatically in every department of a mill. Fig. 2 shows the variation of load on a motor driving a group of twelve looms. Fig. 3 represents the variation of load on a motor driving two mules. The time during which one or both machines were stopped can be clearly seen. The consumption of electricity varies in accordance with the load, and it will be noted that the average consumption is about one-half of the maximum; that is to say, a perfectly steady load of the same horse-power would have consumed twice the number of units. Fig. 4 indicates the variation of load on a motor driving a milling machine, teazer, and willey. It is obvious that the energy consumed was extremely small in comparison with the maximum load. With the knowledge gained by such records as these it is quite easy for the engineer to estimate closely the amount of electricity required per annum to drive any class of machin-

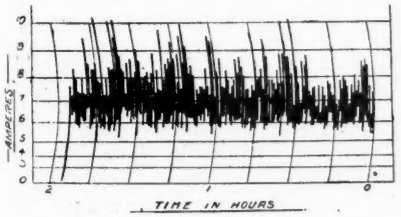


FIG. 2.—LOAD CURVE, LOOMS.

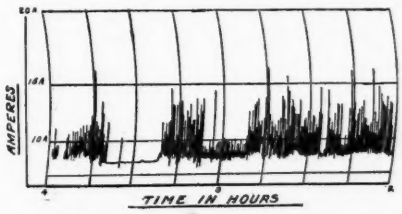


FIG. 3.—LOAD CURVE, MULES.

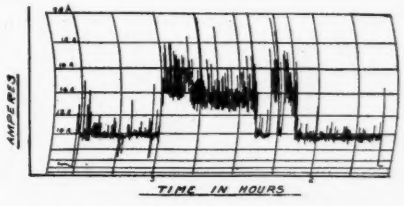


FIG. 4.—LOAD CURVE, MILLING.

[1] A paper read before the Bradford (England) Engineering Society, November 4.

ery. Furthermore, one is frequently able to point out that a certain machine is consuming more power than is consistent with proper working. Faulty adjustment, stiff places, and other faults are in this way very easily detected.

The Individual Drive—A disadvantage of the collective mechanical driving of various classes of machinery from an engine, which is not generally appreciated, is that of the reflection of speed irregularities from one class of machine to another. For example, the variable load due to mules causes a variation of speed not only on the mule countershaft, but throughout the whole mill, so that the carding machines or spinning frames in another department suffer a variation of speed, which tends to decrease the uniformity and quantity of the rove or thread they produce.

In the individual drive each particular operation is independent of any other. The first important advantage of the individual drive is the elimination of belts, gearing and shafting. This represents a considerable reduction in the power required to drive the machinery. In a number of mills tested by the author the loss of power in engine shafting, bearings, belts, etc., amounted to from thirty to fifty per cent of the total indicated by the engine. Tests of various mills have shown that the power taken to drive 100 feet of shafting, running light, amounts to one unit per hour on an average. Belts are equally bad offenders. In a paper before this society, read by H. A. Jones in 1905, particulars of tests were given, showing that with belt driving the loss amounted to five per cent per belt, and with rope driving 6.6 per cent. All these losses of power are difficult to check with the mechanical drive, and they all increase with age. The no-load "friction" card of an engine does not give the true power, as both bearing and belting losses are greater as the load increases, due to the extra pull. Mill fires have often been attributed to overheated bearings; with the electrical drive the motor ammeter would show an increase of load due to such a cause, and the danger would be removed at once. Gear losses are considerably more than those of belt or ropes, and when we consider speed records we shall see a further disadvantage. This matter of speed, however, is so important that it will be treated separately.

The second great advantage is in the freedom from limitation as to the position of machines which is imposed by the nature of the mechanical drive. Machines can be arranged with only one object in view, *viz.:* the economical handling of the products of manufacture. Such processes as rag-grinding and willeying can be performed in outlying sheds removed from the main buildings. Washing, dyeing and milling can be carried on in a position in which the steam and moisture are not conveyed to other parts of the mill. Every odd corner of a site can be utilized. Furthermore, where the principle of the individual drive is adopted to its fullest extent, *viz.,* a motor to each machine, then each machine is entirely independent of its neighbors, and if stopped is taking no power at all. The effect of stopping and starting a loom in a group is felt by each of the other machines, and produces a variation of speed, with a corresponding tearing of the threads and a variation of the texture of the material. This cause being removed, a higher maximum speed may be and is adopted with safety. A case of interest may be quoted. In a group of looms mechanically driven, the tachograph showed a considerable variation of speed on the countershaft, which ran at eighty-four revolutions per minute. On conversion to electrical driving the speed variation was diminished and the speed of the countershaft raised to ninety-six revolutions per minute, without increasing the loom stoppages due to broken ends, etc. The output of the looms was increased in all by twenty-four per cent. The removal of shafting and belts admits more light, and removes a principal cause of dust and dirt. The silk manufacturers in Switzerland and Italy, where the weaving is carried on electrically, consider this a potent reason. Cleanliness and saving of space have been noted. The motor may be perched on the wall or roof; may be underground or on the floor; in fact, may be put anywhere out of the way.

The power costs of each department can be accurately determined, and a check kept on the efficient working of the machines and their minders. Instruments recording the variations of load, such as were used to take the records above shown, may be permanently installed. Where this has been done many interesting things have been noticed. How, for example, the time taken to get all machines running is longer on Monday than any other morning; how there is quite a spurt in production when the owner appears on the scene; and how human nature anticipates the week-end stoppage on Saturday mornings. All these points tell on output, and the instruments are always on the watch.

Economical Use of Capital—In the matter of capital cost the electrical drive effects considerable saving in a new mill. The building may be much lighter in construction, due to the lessened weight of shafting, and the following reductions may be taken as results to be expected:

Reduction in cost of building, ten per cent.

Reduction in cost of shafting, sixty per cent.

Reduction in cost of belting and ropes, sixty-six per cent.

Where the electric power is taken from a public supply there is a further reduction in that the cost of the engine, boilers, chimney and buildings, mill, dam, etc., is avoided. Manufacturers who have converted existing mills to the electric drive, taking a public supply, have, in many cases, paid the greater part of the cost of conversion out of the money realized from the shafting, pulleys, etc., removed. The reduction in the amount of capital spent on machinery which is not directly productive, such as steam engines, shafting, etc., has an important effect on the return on the capital expended in a mill. For example, a mill requiring 200 horse-power may be assumed to have cost $50,000, of which productive machinery cost, say, $25,000, and steam plant $12,500, the corresponding cost of an electrical equipment being $5,000. Now, assume the gross profit on the business was thirty per cent on the turnover before paying power costs, management charges, rent and rates, etc. This profit is earned by the productive machinery, and if the $7,500 difference between the cost of mechanical and electrical drive be spent on further productive machinery, we have in one case $25,000, and in the other $32,500 of directly money earning plant, with the gross profits increased in the same proportion, *viz.,* thirteen to ten, and the net profit, as the management charges are unaltered, at a still greater rate.

Effect of Speed on Output—The most important claim that can be made for electric driving from a public supply is that of increased output due to steadiness of speed. The Yorkshire Electric Power Company's supply is by three-phase alternating current, the power being generated by steam turbines whose speed is practically constant, there being no cyclical irregularities such as occur with reciprocating engines. The type of motor

driven from this supply—the alternating-current induction motor—has the property of running within two per cent of synchronism at all loads, which is to say that the speed of any motor on the system is absolutely determined by the speed of the power-station turbines, and is, therefore, uniform day in and day out. This property of the alternating current is well recognized, as may be realized from the fact that in some German towns the public clocks are driven by the electrical supply. So, if a motor is coupled to each machine, the machine will run at constant speed, independent of load, climatic conditions, or other causes which affect belt transmission. In a number of mechanically driven mills a speed recorder is fixed on the engine and it usually shows a fairly steady reading; but steady speed is wanted at the machines, and in between them and the engines there are belts and ropes slipping and varying all the time. The result may be seen from some of the accompanying curves taken by a sensitive and accurate speed recorder.

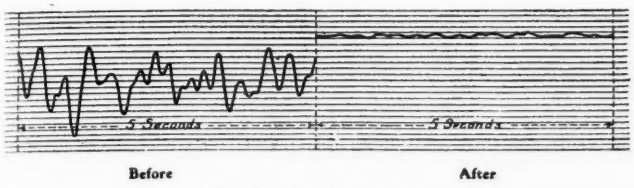


FIG. 5.—SPEED CURVE.

Fig. 5 shows the variation of speed on a mule countershaft before conversion to the electric drive and after. The average speed in the one case is fifteen per cent lower than the other. In the second case, in fact, it was found possible to increase the maximum speed due to the absence of irregularities, so that there was a twofold gain of speed and output. Moreover the quality of the thread spun was improved. Examination of the yarn or cloth produced by the two drives bears out the fact that not only is quantity improved, but also the quality.

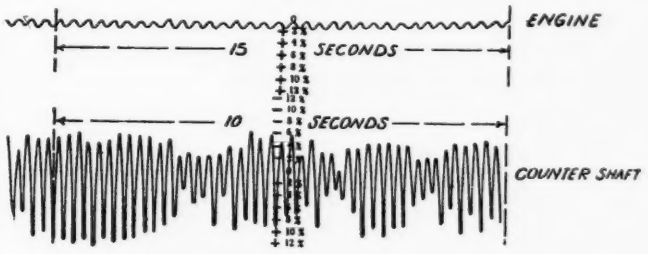


FIG. 6.—SPEED CURVES, VARIATION THREE PER CENT AND TWENTY PER CENT.

Fig. 6 is of interest as showing the corresponding variations of speed on an engine crankshaft and counter-shaft driven mechanically from it, fourteen looms being driven from the countershaft. The speed variation on the engine is only three per cent, but on the loom countershaft it rises to twenty per cent. This result was obtained in one of the most modern and best equipped mills in the district. Compare this with Fig. 7 which shows the speed variation of the loom shaft when converted to the electric drive, reduced to three per cent. Fig. 8 gives a comparison of the speed of mechanically and electrically driven carding sets. Fig. 9 shows the effect of spur gearing. The ideal rolling of the pitch circles, which we assume cycloidal and involute teeth to give us, is in practice obviously not obtained. To put the importance of speed before you in a simple manner a hypothetical case may be taken of a mill having an annual turnover of $250,000 per annum. In one case it is assumed that power is obtained from the mill engine, in the other that the public electric supply is used, with a consequent increase of output of ten per cent. It is assumed that as a portion of the wages paid is at piecework rates the wages are increased five per cent. The trading results would be as follows:

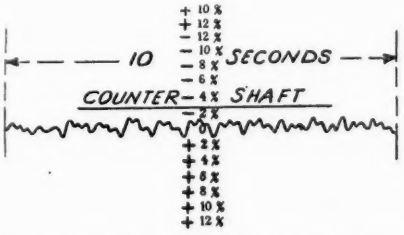


FIG. 7.—SPEED CURVE, VARIATION THREE PER CENT.

COMPARISON OF COSTS AND PROFITS.

	MECHANICAL DRIVE. Turnover $250,000 per annum.	ELECTRICAL DRIVE. Turnover $250,000 per annum. Add 10 per cent 25,000 per annum.
		$275,000
Material	$100,000	$110,000
Wages	75,000	78,750
Management, Rent, etc.	12,500	12,500
Heating, etc.		5,000
Power and Heat	12,500	7,500
Profit	50,000	61,250

It will be seen that the increased output due to steady speed represents an extra profit of $12,250, an amount more than sufficient to pay the electric power bill.

Advantages of a Public Supply—The advantages of a public supply may be summarized as:

(1) Reduction in capital expenditure or an equivalent increase in production with the same expenditure.

(2) Steadier speed at all loads, due to the larger generating sets supplied by the power company.

(3) Greater security of supply, due to the provision of spare plant by the power company.

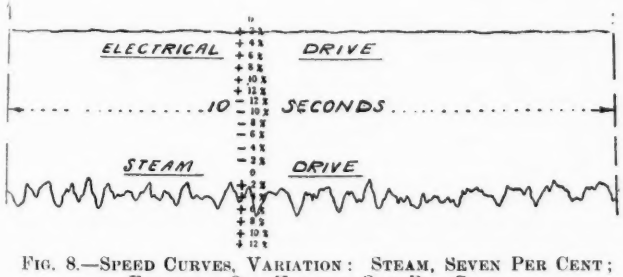


FIG. 8.—SPEED CURVES, VARIATION: STEAM, SEVEN PER CENT; ELECTRIC, ONE-HALF OF ONE PER CENT.

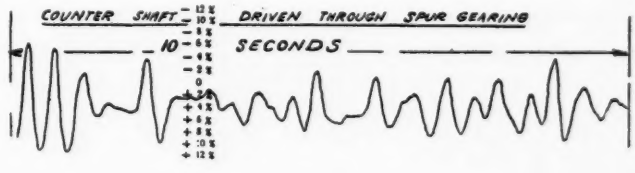


FIG. 9.—SPEED CURVE, VARIATION EIGHTEEN PER CENT.

(4) Freedom from necessity to watch the coal market and keep in touch with the improvements in steam plant.

(5) Freedom to make extensions or alterations and to run overtime in any or all departments at a cost proportionate to the power used. The heavy cost of running overtime in one department of a mechanically driven mill is avoided.

(6) Capital is expended on motors having a high efficiency, which does not decrease with age; expenditure on steam plant is on machinery which not only depreciates in value, but decreases in efficiency.

(7) Cheaper power.

I have put the point of cost last, as although the public supply can be, and is, given cheaper in many cases than the cost of power in isolated plants, yet the great advantages of increased output per machine and increased productive machinery per dollar of capital outweigh the power costs considerably, and if these be taken into account the price which the manufacturer can afford to pay for the public supply is much higher than that at which it can be bought. The power costs in textile manufacture are usually a small proportion of the total costs of production and their importance compared to increase of output is small. Where capital has to be spent on a new mill there can be no doubt as to the advantage of the public supply, and manufacturers whose mills are already equipped can not afford to be left behind in this matter. Finally, a word of warning. The results indicated above can only be obtained when the electrical installation is designed by some one thoroughly familiar with the problem. Early experiences of electrical driving were in some cases unsatisfactory for this reason.

BOOK REVIEWS.

"Elektrische Fernphotagraphie und Ahnliches." Dr. Arthur Korn. Leipsic. Published by S. Hirzel. Paper. 88 pages. Illustrated. 5 by 7½ inches. Price, 2 marks.

In this monograph Dr. Arthur Korn describes in considerable detail the method of transmitting pictures which he has developed, which, to-day, is one of the most promising. He also shows how his system may be employed for telautographic transmission of messages.

"Das Problem der Schwingungserzengung." Dr. H. Barkhausen. Leipsic. S. Hirzel. Paper. 114 pages. Illustrated. 6 by 9 inches. Price, 4 marks.

A discussion of the various methods of setting up rapid oscillations, particularly those of an electrical nature, is given in this monograph, the author taking up not only the theoretical considerations, but explaining the results which may be accomplished by the various arrangements. In the concluding part of the treatise a discussion of mechanical methods for setting up vibrations is given in brief form.

"Electrical Installations of the United States Navy." Commander Burns T. Walling and Julius Martin. Annapolis. United States Naval Institute. Cloth. 648 pages. Illustrated. 6 by 9½ inches. Price $6.00.

This is a manual of the approved electrical material, of the methods of installing, inspecting and caring for it, prepared to fill the need of the United States Navy. It covers every phase of the use of electricity on shipboard. In each case the particular device under consideration is described, the principles of its operation are explained, its characteristics of behavior are stated and tables are given showing the dimensions and sizes of standard makes. Throughout the treatment is most thorough. The Navy Department rules for installing all apparatus are given as well as those governing the selection, inspection and care of each and every device.

"The Design of Walls, Bins and Grain Elevators." Milo S. Ketchum. New York. Engineering News Publishing Co. 394 pages. 6½ by 9 inches. Illustrated. Furnished by the ELECTRICAL REVIEW for $4.

In this work the author gives a systematic analysis of the stresses due to granular materials and a discussion of the principles of the design and details of structures for containing such materials. He first takes up the design of retaining walls, discussing the various theories used in such design and giving a chapter on reinforced concrete walls. The results of experiments on such walls are also given, as well as descriptions of a number of notable walls. He next takes up the design of coal and ore bins, following much the same method of treatment, and in the last part of the book the design of grain bins and elevators is discussed. In each case not only is the principle of design carefully explained, but the modifications necessary in practical construction as well as the many minor details such as painting, etc., are carefully gone into.

"A Text-Book of Electrical Engineering." Adolf Thomälen. Translated by George W. O. Howe. New York. Longmans, Green & Company. Cloth. 456 pages. Illustrated. 6½ by 10 inches. Furnished by the ELECTRICAL REVIEW for $4.20.

In the preface of this book the translator says that while contemplating the preparation of a suitable text-book for his students at the Central Technical College of London, his attention was called to Dr. Thomälen's book and this covered so well the ground over which he desired to take his students that he translated it and added slightly at certain points where he wished to go more into detail. Examining the book with this object in view, it seems admirably suited for its purpose. It is intended to cover the second and third years' work of the students, corresponding probably to the junior and first half of the sophomore year in this country. It is purposely limited to theory and principle as the details of construction are not dwelt upon, although a few types of machines are illustrated merely to show the principle upon which they work. It should be said here that the title of the book appears somewhat too broad, as it deals merely with the theory of electrical currents and with the principles of the construction and behavior of electrical machinery. It does not attempt to go into special branches of the art of electrical applications such as electric lighting, electric railway or telephone, but adheres strictly to a discussion of dynamos, motors and transformers. But the fault of the title is one which it shares in common with many other foreign electrical text-books. The book begins with a clear discussion of the theory of electrical currents, work usually given in the second year's college physics in this country. It then takes up magnetism, discussing the laws and the characteristics of magnetic materials. It next passes to a discussion of direct-current machines, the principles of construction and their characteristics of operation. Alternating currents are then taken up, followed by a discussion of the theory of transformers, of alternators of all types and of their behavior in operation. Alternating-current motors are next considered, all types being taken up in turn. The treatment throughout can not be called analytical, although mathematics are employed wherever they will help, but this is done in a simple though thorough way. In his method of treatment the author is fortunate since he puts in a clear light matters which are too frequently discussed only graphically or by means of the calculus, and hence convey but little physical meaning to the student. As an example, his discussion of the regulation of alternators brings out clearly the various factors entering into it, so that when he then applies the graphical treatment it is simple and easily followed. It may safely be said that the student who will study this book faithfully should have little difficulty in grasping the principles as they are expounded, and if he does this he will surely have a thorough grounding in the fundamentals of electrical engineering.

ENERGY TRANSFORMATIONS FROM THE ELECTRICAL ENGINEERS' STANDPOINT.

BY H. M. HOBART.

Electrical engineers are chiefly concerned with three forms of energy, namely: heat energy, electrical energy and mechanical energy.

When energy manifests itself in the form of heat energy, it is convenient to call it briefly "heat"; when in the form of electrical energy, it may be called "electricity." Finally, when in the form of mechanical energy, it may be called "work."

Unit of Energy—The quantity of energy when in any of these forms, may be expressed in kilowatt-hours.

Kilowatt-Hour—The most frequently occurring occasions when we must express energy quantitatively are those on which it is being transformed from one kind into another, as, for instance, from electricity into heat. The kilowatt-hour is one thousand watt-hours. The watt-hour is the quantity of electricity which is transformed into heat in a wire of one-ohm resistance when a current of one ampere flows through it for one hour. As a potential difference of one volt is required to produce a current of one ampere in a circuit of one-ohm resistance, one watt-hour is equal to one volt-ampere hour for continuous current or alternating current at unity power-factor. It is, however, to be noted that in heavy electrical engineering the watt-hour is an inconveniently small quantity and the kilowatt-hour is more convenient and is thus taken as the unit of energy.

In the illustrative examples which are to follow, it will appear that even the kilowatt-hour is often an inconveniently small unit, for in some departments of heavy electrical engineering, undertakings involving millions of kilowatt-hours are dealt with.

It has been customary in England to denote this quantity of electrical energy as one "Board of Trade Unit," since it is a unit which has been officially adopted by the British Board of Trade, and it is still frequently expressed in this way. It is, however, more often expressed as one kilowatt-hour.

When no ambiguity is thereby introduced, it is often customary briefly to designate this quantity of energy as one "unit"; but this course is not to be recommended, as the term "unit" should be reserved for use in its more general sense.

In this article the following terms are used in dealing with quantities of energy:

1 watt-hour.

1 kilowatt-hour = 1,000 watt-hours.

Weight and Volume—The weight of one cubic metre of water at a temperature of four degrees[1] is termed one ton.

1 ton = weight of one cubic metre of water.

1 ton = weight of 1,000 cubic decimetres of water.

1 ton = weight of 1,000 litres of water.

1 ton = 1,000 kilogrammes.

1 ton = 1,000,000 grammes.

Pressure—The unit of pressure is one kilogramme per square centimetre.[2] When not otherwise expressly stated, absolute pressures are to be understood. That is to say, pressures are referred to an absolute vacuum and not to atmospheric pressure.

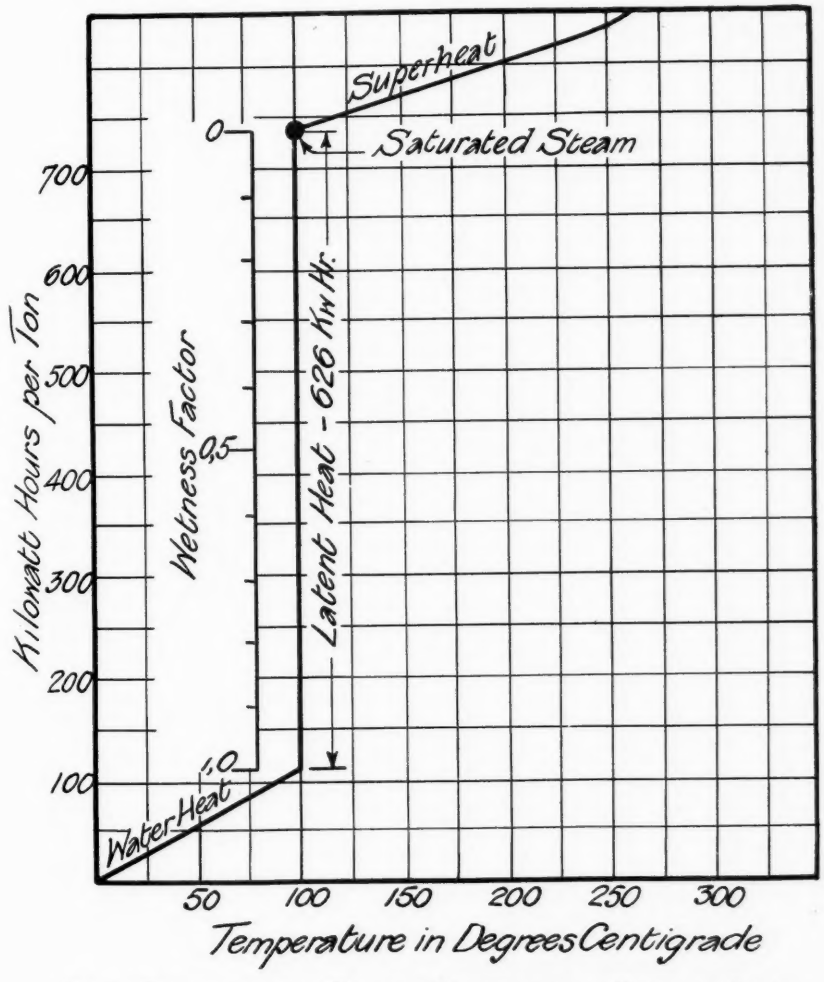


FIG. 1.—RELATION BETWEEN HEAT AND TEMPERATURE FOR WATER AND STEAM AT ATMOSPHERIC PRESSURE.

RELATION BETWEEN HEAT AND TEMPERATURE.

The relation between heat and temperature for water and steam may be illustrated by means of the curves in Fig. 1, which represent the occurrences attending the absorption of energy by one ton of water; *i. e.*, the "heating" of one ton of water. During the entire operation, the specific pressure is maintained constant at one kilogramme. The curve consists of three distinct portions. The first portion, marked "Water Heat," slopes upward. The second portion, marked "Latent Heat," is vertical. The third portion, which is marked "Superheat," is slightly curved, but its general character is very similar to that of the first portion.

The first portion of the curve represents the heating of water at atmospheric

[1] Four degrees is the temperature of maximum density of water. Throughout this article the centigrade temperature scale is employed, and instead of four degrees centigrade this temperature is indicated by four degrees.

[2] This pressure of one kilogramme per square centimetre is equivalent to the pressure of a mercury column with a height of 735.5 millimetres. It is almost equivalent to the normal atmospheric pressure. For this reason the unit of pressure is sometimes designated a "metric atmosphere." It has the advantage over the ordinary "atmosphere" that it is independent of barometric variations.

pressure. For all practical purposes the line is straight, since the rise in temperature is closely proportional to the heat added.

A consideration of the extent of the deviation from a straight line must necessarily be prefaced by a discussion of the "Specific Heat." The meaning of the term "Specific Heat" may be illustrated by an example: At eighty degrees 1,172 kilowatt-hours are required to raise the temperature of one ton of water by one degree. The corresponding amount of energy required to raise by one degree the temperature of one ton of water at zero degrees is only 1,160 kilowatt-hours. The specific heat of water at eighty degrees is obtained by dividing 1,172 by 1,160 and is consequently equal to 1.010. The quantity of energy, 1,160 kilowatt-hours, which is absorbed in raising the temperature of one ton of water from zero degrees to one degree is the standard of reference as regards specific heat, since water at zero degrees has been chosen as the standard substance, and its specific heat at that temperature is taken as unity.

The specific heat of any body at any temperature is obtained in the above manner by dividing the kilowatt-hours required to cause a rise of temperature of one degree by 1,160, as this is the energy in kilowatt-hours required to raise one ton of water at zero degrees by one degree.

The values of the specific heat of water at various temperatures are given in Table I.

TABLE I.

THE SPECIFIC HEAT OF WATER AT VARIOUS TEMPERATURES.

Temperature in Degrees Centigrade.	Specific Heat.	Energy in Kilowatt-Hours Required to Raise One Ton of Water by One Degree Centigrade.
0	1,000	1,160
20	1,001	1,161
40	1,003	1,163
60	1,006	1,167
80	1,010	1,172
100	1,013	1,175
120	1,018	1,181
140	1,023	1,187
160	1,029	1,193
180	1,036	1,202
200	1,044	1,211

When at atmospheric pressure a ton of water has been brought to a temperature of 100 degrees, the absorption of additional energy does not cause a further rise in temperature until this additional energy has amounted to 580 kilowatt-hours. Consequently the second portion of the curve in Fig. 1 is a vertical line of a length corresponding to 626 kilowatt-hours.

The heat thus required to be added before any further rise in temperature is occasioned is called the "latent heat" of the water, or the latent heat of vaporization or evaporation of water.

The energy corresponding to the latent heat may be divided into two components. The first component represents the energy necessary to change the molecular state, and is termed the internal latent heat. The second component represents the energy required to expand the water against the surrounding pressure from its liquid volume to its gaseous volume, *i. e.*, to its volume when converted into steam. This component is much smaller than the first component. It is termed the external latent heat, and ranges, according to the specific pressure, from six per cent to ten per cent of the total latent heat.

If, instead of atmospheric pressure, other pressures are maintained during the conversion of one ton of water into steam, the latent heat, as well as its two components, has other values. These are given in Table II for a number of different pressures. In the second column of the table are given the corresponding temperatures at which vaporization occurs.

TABLE II.

TABLE OF THE INTERNAL AND THE EXTERNAL LATENT HEAT OF VAPORIZATION OF WATER.

Absolute Pressure in Kg. per Sq. Cm.	Temperature of Vaporization in Degrees Centigrade.	Latent Heat of Vaporization in Kilowatt-Hours per Ton.		
		Internal.	External.	Total.
1	99	579	47	626
2	120	563	49	612
4	143	541	51	592
8	170	518	53	571
12	187	502	54	556
16	200	487	55	542
20	211	475	56	531

Prior to the absorption by the ton of water at vaporization temperature, of the entire amount of energy corresponding to its latent heat, the ton of water will not have been converted entirely into steam, but will be a mixture of water and steam. At atmospheric pressure the latent heat of one ton of steam is 626 kilowatt-hours. When only half of this quantity of energy, *i. e.*, when only 313 kilowatt-hours have been absorbed, we shall have a mixture consisting of 0.5 ton of water and 0.5 ton of steam. To the diagram in Fig. 1 has been added a scale showing the "wetness" of the steam at various stages of the process of imparting 626 kilowatt-hours

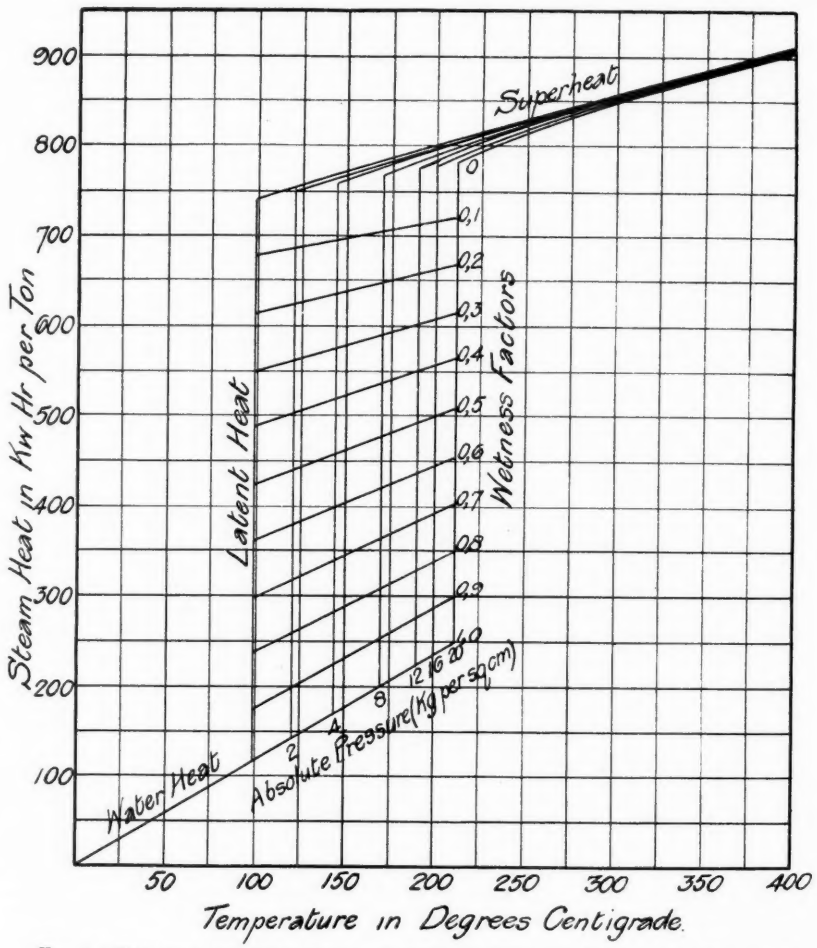


FIG. 2.—RELATION BETWEEN HEAT AND TEMPERATURE FOR WATER AND STEAM AT VARIOUS PRESSURES.

to the ton of water. At the commencement of the process the "wetness" is 100 per cent, or we may say that the steam has a wetness factor of 1.00. When 125 kilowatt-hours have been absorbed the wetness factor is 0.80, and when the entire 626 kilowatt-hours have been absorbed the wetness factor is 0.00, and we have so-called "saturated" steam.

Further additions of heat are accompanied by increase of temperature, and the steam is said to be "superheated." This part of the process corresponds to the right-hand sloping portion of the diagram in Fig. 1. The angle at which this portion of the diagram slopes upward is dependent upon the specific heat of superheated steam.

The specific heat of superheated steam varies considerably with the temperature and pressure. It is, roughly, about half of that of water. Hence a given quantity of energy imparted to a ton of steam will raise its temperature through about twice as many degrees as the same amount of energy imparted to one ton of water.

These data are embodied in the diagrams in Fig. 2, where are drawn, for various pressures, a set of lines corresponding to those already given in Fig. 1 for an absolute pressure of one kilogramme per square centimetre.

(To be concluded.)

The McCall's Ferry Power Project.

A statement has been made by the McCall's Ferry Power Company, in which the late Charles T. Barney was interested, explaining its stoppage of work. The company is building a dam 2,530 feet long, and a large power house to furnish Baltimore (Md.) and the surrounding country with electrical energy. H. F. Dimock, president of the company, states that there was no money on deposit in the Knickerbocker Trust Company, so there is no financial loss on that score. The suspension of the Knickerbocker Trust Company did, however, interfere with the McCall's Ferry Power Company's securing money to carry on the work. At the moment it is still impossible to make any new financial arrangements for that purpose, and work has therefore been suspended temporarily. Owing to the fact that eighty per cent of the work has been completed, it can be temporarily stopped without incurring the danger of damage from floods.

The Raising of Power-Factors and the Regulation of Potential by the Use of Rotary Condensers.

One of the very useful papers read at the twenty-third annual meeting of the Association of Edison Illuminating Companies, Hot Springs, Va., last September, was presented by Charles W. Stone, entitled "The Raising of Power-Factors and the Regulation of Potential by the Use of Rotary Condensers." An abstract of this paper follows:

Synchronous motors, unlike induction motors, run at a certain synchronous speed, independent of the voltage and power-factor of the system from which they operate. They also draw a certain mean current from the line with a fixed load. This current input can be varied through a wide range by changing the field excitation. If the excitation is increased with the load unchanged, the current input increases, but is leading in respect to the line current. If, however, the excitation is decreased, the current input is increased, but is lagging with respect to the line current.

The induction motor is more like a direct-current motor in its action. The current input is a fixed quantity and is dependent only on the voltage of the supply system and the design of the motor and the load. This current is always lagging in respect to the line current. At light loads the amount of lag is increased, so that with many motors lightly loaded the effect is to lower the power-factor of the entire system.

All alternating-current systems used for lighting distribution have in addition to the power load of induction motors a comparatively large number of transformers which when lightly loaded result in lowering the power-factor of the system, as do the arc lights, either series or multiple.

Low power-factor on a system means greatly reduced capacity of generators, transformers, lines, etc. The regulation of the entire system is also much poorer.

Alternating-current generators are all rated in kilovolt-ampere output; that is, a 100-kilowatt generator is supposed to deliver its full 100-kilowatt output at 100 per cent power-factor at normal voltage and at normal temperatures, but if the power-factor should be sixty per cent lagging, the energy output of the machine would only be about sixty kilowatts, and yet the current would be the same and consequently the heating would be the same as when delivering 100 kilowatts at 100 per cent power-factor. Unless the generator were specially designed for low power-factors, it is also probable that it would not be possible to obtain normal voltage on the machine, as the low power-factor current in the armature opposes the flux set up by the fields, and in consequence tends to demagnetize them, resulting in low voltage. The field current would therefore have to be increased sufficiently to overcome this effect, which would often not be possible, as the voltage obtainable from the exciters must be limited.

The regulation of modern belt-driven generators at unity power-factor is usually about eight per cent. At seventy per cent lagging power-factor it would be about twenty-five per cent. An engine-driven generator with the same regulation at unity power-factor would probably be as bad as thirty per cent at seventy per cent power-factor; a steam-turbine-driven generator would be about twenty to twenty-two per cent.

Transformers are reduced in capacity in a similar ratio to the reduction in capacity of generators. Their regulation, although usually inherently better, being about one and one-half to two per cent at unity power-factor for small lighting transformers, would be about four or five per cent at seventy per cent power-factor. Larger transformers with a regulation of one per cent or better, at unity power-factor, would be about three per cent at seventy per cent power-factor.

The effect of low power-factor on the lines can best be shown by example:

If we assume a distance of five miles and a load of 1,000 kilowatts and desire to deliver this load at a potential of about 6,000 volts with an energy loss of ten per cent, each conductor at unity power-factor would have to be 79,200 circular mills, at ninety per cent power-factor 97,533 circular mils, and at sixty per cent power-factor 218,000 circular mils; or in other words, at the low power-factor of sixty per cent, the investment in copper alone would be two and eight-tenths times as much. If the same size of wire were used at both unity and sixty per cent lagging power-factor, the energy loss would be about two and eight-tenths times the loss at unity power-factor, or about twenty-eight per cent.

It is apparent, therefore, that if some means can be provided to raise the power-

factor of the system, the apparatus can be operated at its full capacity and with normal regulation.

The synchronous motor can be used for this purpose, and at the same time can be used to develop mechanical energy. When used solely to supply leading current to the system they are called rotary condensers.

The most efficient way to use these rotary condensers is to arrange to load them as a motor with seventy-one per cent of their capacity, and over-excite their fields sufficiently to make them take normal full-load current. The resultant power-factor would then be seventy-one per cent leading, and the wattless component or condenser component would be seventy-one per cent.

If we assume a system with an inductive load of 1,414 apparent kilowatts, the energy load being 1,000 kilowatts, the power-factor would be seventy-one per cent lagging and the wattless component would be 1,000 kilovolt-amperes. By adding 500 kilovolt-amperes leading, the apparent load would be reduced to 1,120 kilovolt-amperes, or a saving of $1,414 - 1,120 = 294$ kilovolt-amperes. If, however, we add 500 leading kilovolt-amperes more, it is apparent that only $1,120 - 1,000$ kilovolt-amperes, or 120 kilovolt-amperes, would be saved, showing the greater value of leading current at low power-factor.

If we figure out what the necessary extra investment in copper would be with the low power-factor load with copper at twenty-two cents per pound, we find that 29,292 pounds more copper is needed with the power-factor of sixty per cent than with the power-factor of ninety per cent, or $29,292 \times 22$, which means a total extra investment in copper alone of $6,444. A synchronous motor of sufficient capacity to accomplish the same result would cost about $4,000, or, in other words, it would cost far less to use the rotary condenser than to pay for the extra copper in the line, and at the same time obtain considerable more capacity from the generators, transformers, etc.

This motor could thus be installed and run idle; *i.e.*, with no load, and simply supply leading current to the line and pay for itself in a short time.

If the motor can at the same time be used to deliver any mechanical energy, as pointed out above, the saving would be even greater.

It should also be noted that, if the rotary condenser is installed in the generating station, the only gain will be in capacity of the station apparatus and in its regulation. However, if it is installed at the end of the line, it would not only accomplish everything that it would if in the generating station, but would also increase the capacity and better the regulation of the line transformers, etc.

In general it would appear that there are few modern central stations of today which are operating alternating-current systems of distribution that could not find use for such machines. It is also evident that if the companies that use motor-generator sets to transform the alternating current to direct current, would purchase synchronous motors and make them of a little larger capacity than required for the mechanical power, compensation could readily be obtained for the low power-factor which of necessity exists in such systems.

So far the discussion has been confined entirely to the use of rotary condensers to raise the power-factor of the system. There is, however, one other very useful function of such machines, which I will describe briefly.

As all transmission circuits have an appreciable ohmic resistance and reactance, there is a certain voltage difference between the generating and receiving ends of the circuit, this difference becoming greater as the load on the circuit becomes greater.

By using a synchronous motor and varying the field excitation, it will readily be seen that the effect of the reactance in the line can be increased, and consequently the voltage drop increased; and, by over-exciting the motor, sufficient leading current can be inserted in the line to overcome the effect of the reactance of the circuit with a consequent increase in potential at the end of the line. It is usually more convenient to maintain a uniform potential at the generating station busbars, which naturally results in too high potential at the substation or centre of distribution during the light-load period and too low voltage during the time of heavy load.

The function of the synchronous motor with a Tirrill regulator would therefore be to control the voltage at the centre of distribution, keeping it constant at all loads.

The synchronous motor can be used to the best advantage when it delivers full leading current at full load, and full lagging current at light load on the receiving circuit.

As a rule the average circuit does not have sufficient resistance and reactance to make it possible to use the most economical motor, and it is therefore desirable to insert a small reactance in series with the line. Of course the reactance should not be too great, or other troubles will appear. In general it can be said that the total reactance of the circuit which includes the reactance of the transformers should be about fifteen to twenty per cent.

In order to get the best results, the synchronous motor should be designed to have good regulation and low saturation, as the Tirrill regulator works best when it is not called upon to take care of more than 100 per cent change in field excitation. This means that the synchronous motor should be able to deliver from full lagging to full leading current with a change of 100 per cent in its field. Such a motor is therefore designed to have close regulation. The standard motors as usually built have a short circuit current of one and one-half to two times the normal, and therefore can not be used to their full capacity as compensators. Nevertheless, it is usually better to use the standard motor, as it means quicker delivery and would probably cost less to build than would the special motor of somewhat less capacity.

The synchronous motor when used to control the voltage can also be used at the same time to develop mechanical energy; the relations between the amount of possible mechanical to compensating output being as follows:

Per Cent Power Output.	Per Cent Phase Control.
100	0
95	31
90	43
80	59
71	71
50	87

In order to better illustrate the output of such motors, we will consider that in the substation we already have installed a synchronous motor of 500-kilowatt capacity driving some other piece of apparatus, and it is desired to use this motor at the same time to act as a potential regulator. We find that it could deliver about 155 kilowatts as a compensator, and yet the capacity of the motor for developing mechanical energy would only be reduced five per cent, and full load current would not be exceeded.

Electrical Notes from Europe.

(By Our Special Correspondent.)

THE tenth annual automobile show was opened on November 12, at Paris, and promises to be especially brilliant this season. The number of exhibits is considerably increased this year, which made it necessary to erect a temporary building on the Invalides grounds on the other side of the Seine. An annex building had been already erected for this purpose last year, but this time its area is greatly increased in order to obtain the needed space. Here are placed certain classes of exhibits, such as the heavy-weight cars, vans or tractors, which are always a prominent feature of the show. Machine tools specially adapted for automobile work are shown in actual operation. Gas, alcohol and acetylene apparatus are also to be seen here. Another section comprises boats and launches of all kinds. There are a number of new electromobile cars to be seen at the show this year. As usual, the stands in the Grand Palace are tastefully designed and the electric lighting, which plays an important part in the general appearance of the show, is well carried out. This year's show being the decennial exposition, the committee made special efforts to have it as attractive as possible. One of the features is a retrospective exposition, in which one obtains a good idea of the progress which has been made up to the present. The date of the show was advanced this year from December 1 to November 12, in order to have it closed before the end of the year, and thus it does not conflict with the business operations which are peculiar to that period.

For some time past the French Government has been considering the feasibility of erecting radio-telegraph stations at different points on the coast, so as to connect with the vessels of the war and merchant fleets. The result is that a number of coast stations will be erected in the near future, starting with two stations which are most needed at present. One of these will be situated on the Mediterranean coast at Sante-Marie, in the region of Marseilles. A second station will be located not far from Algiers, so as to operate across the Mediterranean. There is already a station placed at Bizerta, near Tunis, which is now working. As to the new posts which it is intended to erect in the near future, these will probably be placed at Boulogne, Havre, La Coubre, Nice and on the coast of Corsica. Not long since the Navy Department decided to carry out a series of trials between some of the vessels of the war fleet which are now in the Mediterranean region, near Marseilles. All these vessels are equipped with radio-telegraph apparatus of late construction. These trials are now going on, and according to reports they appear to be quite satisfactory.

Glass telegraph poles are a novelty which has been brought out in Germany not long since. They are made of reinforced glass, that is, a central core of iron-wire web is used as a foundation, and around this is cast the glass, so that the whole is well consolidated. The method is brought out by a Frankfort inventor and it appears that a factory for making such poles on a large scale is now actually in operation at Grossalmerode. Such poles will have a special advantage in tropical regions, as they are not likely to suffer from effects of climate, nor to be injured by insects.

The French company, known as the "Energie Electrique," is continuing to erect hydraulic plants in the Alpine coast region of France, and at present the stations with the extensive network of power lines which connect them together form the largest system of the kind in Europe. A supply of current is thus secured for the coast towns and cities, such as Nice, Monte Carlo, Cannes and Marseilles. The most recent work which marks this third stage of construction and development of the hydraulic system comprises three new plants which are designed principally to supply Marseilles with current. The complete project calls for three large turbine stations: first, a 20,000-horse-power plant on the Verdon river, at Aiguines; second, an 18,000-horse-power station located on the Durance river at Ventavon, and third, the 15,000-horse-power Brillane plant, also on the Durance river. Of these stations, the last is now completed and has already started working. The Ventavon station is building at present, and the other plant will follow before long. All the power lines are connected together and are designed for 50,000 volts. At present there are three large substations erected. One of these is placed at the town of Arles, on the Rhone, and gives a supply for the locality. The second is at St. Maximin, and the third and largest one at Allauch, just outside of Marseilles. The latter station contains twelve single-phase transformers of 1,000 kilowatts' capacity. On the above system there are also three steam plants now erected, which are used as a reserve. At Arles is a plant which is fitted with three steam-turbine alternators of 1,500 horse-power each. In Marseilles are now running two large stations. One of these, owned by the City Gas Company, has a capacity of 4,500 horse-power in steam turbines and expects to increase this before long to 11,000 horse-power. The second Marseilles plant belongs to the Tramway Company and now has five alternator sets of 1,500 horse-power each. A turbine-alternator group of 1,500 horse-power is soon to be added to this plant. The Brillane station was formally inaugurated during the visit which the Civil Engineers' Society made to this region not long ago. It is one of the best equipped in France. From the dam laid across the Durance there is a canal about four miles long, which leads to the main basin and from this point six penstocks of six feet diameter lead down to the turbine house. In the dynamo room there are now placed five Francis turbine sets of 3,500 horse-power, direct coupled on horizontal shafts to the alternators. The latter are of the 7,500-volt type. In the plant are also installed three smaller turbines for the use of the plant, which are worked from the sixth penstock. A separate building contains fifteen oil transformers with water cooling. These have a capacity of 1,000 kilowatts each, and are connected in groups of three for each alternator. On the main switchboard are two sets of bus-bars for 50,000 volts, to which are connected the secondaries of the transformers. As to the overhead line, it consists at present of six wires and is supported upon trestlework poles placed 220 feet apart.

At Tsingtau, China, the German Government recently installed a radio-telegraph post, using the Slaby-Arco system as constructed by the Telefunken Company.

It is laid out to cover a distance of 120 miles. Up to the present the signals are exchanged only with vessels of the German war fleet, but later on it is proposed to use the station for public service.

In Italy it is proposed to establish a new system for the rapid transit of mail matter between the large cities, according to the recently devised method of Pisicelli-Taeggi. This consists of a tube in which will run small motor-driven cars which carry the mail matter. A very high speed can be obtained by the use of this system. It appears that the Italian Government has taken up the matter and now expects to install such a tube between Rome, Naples and Milan. According to recent experiments, it is estimated that the mail can be carried from Rome to Naples in two hours, where it now takes five hours for the same.

The municipality of Messina proposes to revoke the concession which was granted some years ago to a Belgian company for a system of steam tramway lines and to substitute electric traction on these lines. According to the first concession, the route lay partly in the city and extended to the suburban localities of Barcelona and Giampilieri, lying at thirty and at ten miles distance, respectively. Accordingly the municipal council has advertised for bids for such lines from the leading companies.

At present there are two new electric locomotives running on the Simplon Tunnel section, and they have been recently constructed by the Brown-Boveri firm, the builder of the power locomotives. Like these, they use a double-bow trolley upon the overhead wires, and will make speeds lying between fifteen and fifty miles an hour. There are four axles in all on the locomotive, two of which are driving axles. All four wheels are coupled together and in this case the whole weight of the locomotive serves for the adhesion to the track. Of the company's three-phase type, the two motors are placed in the centre of the locomotive truck and work the driving axles by coupling bars. Each of the motors is rated at 700 horsepower. A short-circuited armature is used on the motors and the latter are operated at low voltage from transformers which the locomotive carries. By changing the field in strength or polarity, four different speeds are obtained. There are two three-phase transformers placed on each locomotive and these have variable secondaries. The total weight of the locomotive is about seventy tons.

An Italian inventor claims to have found a process for rendering celluloid incombustible. This will be of great utility in many ways, and for electric purposes one of the principal advantages will be for accumulator cells. The process is a somewhat complicated one and consists in first dissolving the celluloid in acetone or methyl spirit and treating the solution with various salts or oxides. Using phosphate of iron gives a pearl-gray hue. The celluloid is transparent as usual, while chromate of borium gives a straw color. Phosphate of iron gives a pearl gray hue. The treatment is then continued by means of tetrachloride of carbon and formaldehyde. Finally, the celluloid agglomerates in the solution after being allowed to stand for several hours and floats on the surface. The celluloid paste is then dried and molded. Such treatment, while making the celluloid non-inflammable, does not appear to change its properties.

The Eiffel Tower is now used to indicate the hour and minute at night by means of large figures made up of incandescent lamps. Such figures can be seen at a great distance in the city. The present method has been devised by a Russian engineer, Nicolas Hourko, connected with the government railroads at St. Petersburg. Incandescent lamps placed on special supports form the figures for the hour and minute, such as 8.25 for instance. Every minute the figure is changed and the first figure every hour. The latter is operated by means of a set of relays for throwing on the lamp circuits and the relays are worked by a small clock by means of mercury contacts.

C. L. DURAND.

Paris, November 29.

Electrical Notes from Great Britain.

(By Our British Correspondent.)

THE committee on tramcar brakes, which has already been referred to in these pages, is getting near to the end of its investigations. No further evidence is now to be taken, and the preparation of the final report is stated to be at present proceeding. Those interested in the matter await the findings of this committee of experts with a certain amount of eagerness, and the desire for something authoritative and definite on the braking-equipment question is natural in view of the frequency of serious tramcar accidents of late. It is devoutly to be hoped that the present inquiry will carry us nearer to immunity from such disasters, whether the weakness lie in the need of less complicated and more efficient brakes, or in the want of a better trained human element than is at present at disposal for standing the stress and strain of emergency.

That very unfortunate undertaking, the South Wales Power Distribution Company, which has encountered serious financial tribulation during the past two years, is being divided up into separate sectional concerns. It will be remembered that the necessary financial assistance was not forthcoming to enable its new directors to put the undertaking on a sound basis, clearing out past errors and preparing for reasonable development. Since May, 1906, the four generating stations at Treforest, Bridgend, Neath and Cwmbran have been kept in operation at the expense of the principal consumers. The first-named station is being taken over by a new company, the Treforest Electrical Consumers' Company, Limited (capital, $500,000). It consists of five of the principal consumers so far, and it is going to find an additional $150,000 that is to be spent on increasing the station and mains capacity. Steps are now being taken to form a similar company to take over the Cwmbran station and mains, which have cost over $800,000. The two other stations mentioned above (Bridgend and Neath) are being purchased by the local authorities. This is a sad sort of ending to what was once thought to give reasonable prospects of becoming a fine undertaking, serving a fruitful area of supply.

Shares in submarine-telegraph companies showed considerable depreciation in London during the several days previous

to the Marconi transatlantic transmission. The same nervousness and depreciation occurred on the occasion of the earlier Marconi achievement some five years ago. The probable effects of wireless telegraphy upon submarine-cable business have accordingly once more been the subject of a good deal of comment at meetings of the cable companies held in London during the last few weeks. The speech delivered by Sir John Wolfe Barry, as chairman of the Western Telegraph Company, may be regarded as representing the view of the principal cable interests in regard to the matter. Wireless telegraphy was not regarded as a serious competitor of the cables. The fundamental difficulties and imperfections remained in the want of certainty of transmission, the want of secrecy, and in the confusion which must occur when numerous messages were not conveyed by a direct conductor, such as a land line or a telegraph cable, from point to point, but were thrown with great violence up into the ether, into which they were radiated in all directions, to be disentangled and interpreted at the other side of the globe. To a limited extent tuning met some of the difficulties, but secrecy was only really attainable so long as third parties abstained from tuning their instruments to intercept the messages. The number of gradations of tuning was limited to an extent which seemed to him to be quite incompatible with the requirements of a large telegraphic business. Some 25,000 paying words passed to and from England by cables during a busy hour, and New York expected to receive and answer Stock Exchange telegrams with London in four or five minutes. Sir John thought that, making allowances for tuning, the confusion in the ether would be worse confounded if any considerable number of wireless messages were attempted. Then, further, the longer the distances attempted the more formidable would be the difficulties from magnetic and atmospheric causes. Then, still again, he understood that a wireless sending station of high power could not, as was the case with telegraphy by continuous cables and wires, be at the same time a receiving station, or, in other words, messages could not be sent and received simultaneously, and if this were so, he foresaw the greatest difficulties in dealing with one of the matters which caused constant trouble with any system of telegraphy, *viz.*, the elimination and correction of errors, and the consequent demands for repetition of doubtful signals.

A dividendless report has come from a most unexpected quarter. What with the general stagnation of electrical business, the high costs of material and the low prices obtainable, on the one hand, and on the other the unsatisfactory condition of financial markets, leading the better-class public to defer outlay on luxuries, Messrs. Drake & Gorham, Limited, have had a bad year. The firm has for years specialized in country-mansion installation work, and a very large number of such plants of high-class character have been put into some of the finest residences in England. But the hard financial times through which we have been passing, leading, among other things to a great depreciation in the value of nearly every class of investment, have hindered this department of electrical business for the time being, and the man who has a surplus buys motor-cars rather than put down an installation, if he has to make a choice between the two. At any rate this is Bernard Drake's own observation on the position and he ought to know. The firm has, accordingly, wisely added to its activities those of motor-car purchasers and experts.

The electrobuses which are operating in London with Gould and Tudor batteries appear to be acquitting themselves well. The company's prospectus was received last year with considerable criticism, indeed the concern was almost stifled at its birth. Most of the subscribed capital had to be returned, and the 46,000 shares now issued are held chiefly by friends of the directors who believe in the future of the electrobus. Into the reasons for the criticisms offered, and the details of the original bus, we need not now enter. There are only six or seven vehicles running. Each of these has forty-four two-volt cells of 500 hours' capacity, and the mileage that these batteries can run, allowing for thirty per cent reserve, is put at thirty-six. The Tudor and Gould companies are stated to be quite satisfied with the contracts under which they are working, and will work for another three years, namely, a battery cost of twopence per mile. Although it has running only the small number of buses mentioned, the company has a garage capable of taking sixty or seventy of them. There is not the least doubt that the smooth and quiet running of the electrobuses impresses the mind of the traveling public and that of property-owners whose vials of wrath are continually being poured upon the stormy petrols which shake their houses and fill their streets with smoke and smother and stench, leaving oily traces which will not be removed by street scavengers. According to what one hears the electrobuses cost $3,500 apiece, and those now at work have been costing nine and one-half pence per car-mile and earning one shilling threepence. The company is going to try later to raise $350,000 new capital for building more buses. If it does not commit the errors contained in its former prospectus and can clearly prove its figures as to working cost and earning power, providing well for depreciation possibilities, it will doubtless meet with a reasonable response, because, as we say, the silent running of the buses as they glide through the city streets impresses the public favorably.

There is in course of erection at Spennymoor, for the Durham Electric Power Supply Company, an important generating plant, for which Richardsons-Westgarth are the contractors. There will be four sets driven by turbines having Contraflo condensers; cooling towers and Nesdrum boilers are included. The station will utilize the gas produced from the Weardale Company's coke ovens close at hand. Richardsons-Westgarth are also engaged upon a 12,000-horse-power turbine for the Dunston power station of the County of Durham Electric Power Supply Company. This will be the most powerful yet made for any electric power station in the United Kingdom.

It is stated on very good authority that the establishment strength of the Electrical Engineer Volunteers who, it will be remembered were formed ten or eleven years ago, chiefly at the instigation of the late Dr. John Hopkinson, who devoted a great deal of attention to the matter just prior to his sad death in Switzerland, is being cut down from 750 to 500. As a number of resignations came in from the provinces the vacancies were left unfilled. The strength of the body in London has not been reduced.

The first certain case of electrical suicide in an English central station has taken place at Kingston-on-Thames municipal electricity works. A carpentering

employé who sometimes did work about the station, asked those who knew what were the dangerous parts of the switchboard. Anybody would tell such an inquirer that, in order to show him what to avoid contact with, but in this case, when a fitting opportunity occurred for him to get at the board unnoticed, the said carpenter made a good contact with the terminals of a 2,000-volt main switch. It is indisputable that all the dangerous parts of the board are effectively guarded against accidental contact. Both J. E. Edgcombe, the Kingston engineer, and G. S. Ram, the Government electrical inspector, bore testimony to that fact.

Since the mailing of my last letter, Ascot has been a centre of considerable interest because the gas company there has opened an electric generating station. The company has the honor of being the first gas company in England to put into actual operation electricity supply powers granted by Parliament. The plant comprises a couple of ninety British horse-power Hornsby-Stockport horizontal suction gas engines coupled through flexible couplings to Johnson & Phillips direct-current generators (110 amperes at 460 volts, speed 210 revolutions). A semi-automatic balancer booster works in conjunction with a 240-cell Tudor-type battery. Handcock & Dykes designed and supervised the installation.

A $250,000 contract for an electrical installation at Japanese steel works is now being carried out at Trafford Park, Manchester, by the Lancashire Dynamo Company. There are to be 300 motors for machine tools, gun-boring lathes, cranes, etc., and three 1,000-kilowatt compound interpole generators with slip rings and static balancers, for three-wire supply (440 volts). The contract was placed by Baron Yamanouchi of the Imperial Japanese Navy, and is for the generating station of the Kabushika Kwaisha Mihon Seiko Sho.

The continued absence of Lord Kelvin in Scotland, consequent upon the illness of Lady Kelvin, led to the opening of the winter session of the Institution of Electrical Engineers in London without the customary presidential address. At the opening meeting members plunged straight away into the consideration of the paper by Alexander Russell on the "Dielectric Strength of Insulating Materials and the Grading of Cables." An announcement was made concerning new arrangements that have been introduced regarding the reading of important papers from the provincial sections, at the meetings of the London body.

On November 20, Professor Gisbert Kapp delivered his address as chairman of the Birmingham local section of the institution, "Technical Education" being the theme selected for his remarks.

ALBERT H. BRIDGE.

London, November 29.

Maryland Telephone Company Passes Into New Hands.

On Tuesday, December 3, the Maryland Telephone Company passed into the hands of what are said to be powerful independent interests, who, it is reported, will continue to operate the property in competition with the Chesapeake & Potomac Telephone Company. The property was sold by the Baltimore Electric Company, the stock of which is owned by the Consolidated Gas, Electric Light and Power Company, of Baltimore. The price, it is stated, was in the neighborhood of $300,000.

S. Davies Warfield, chairman of the board of directors of the Consolidated Gas, Electric Light and Power Company, is quoted as saying that at the time of the purchase of the stock of the Baltimore Electric Company plans had been proposed by out-of-town interests to acquire the stock of the Maryland Telephone Company. At that time Mr. Warfield stated that it was not the purpose of the Baltimore Electric Company to remain in the telephone business. Mr. Warfield says that the Maryland Telephone Company has been purchased subject to the $1,000,000 first-mortgage bonds and the $1,155,000 general-mortgage bonds outstanding, and the properties have been turned over to interests having a large experience in the telephone business. The purchasers are represented by H. P. Miller, who has been placed in charge of the property, with headquarters in the Maryland Telephone Building.

A temporary organization has been effected as follows: H. P. Miller, Columbus, Ohio, vice-president. Directors: Joseph Taylor, New York; Dudley G. Browning, New York; F. M. Twomey, New York.

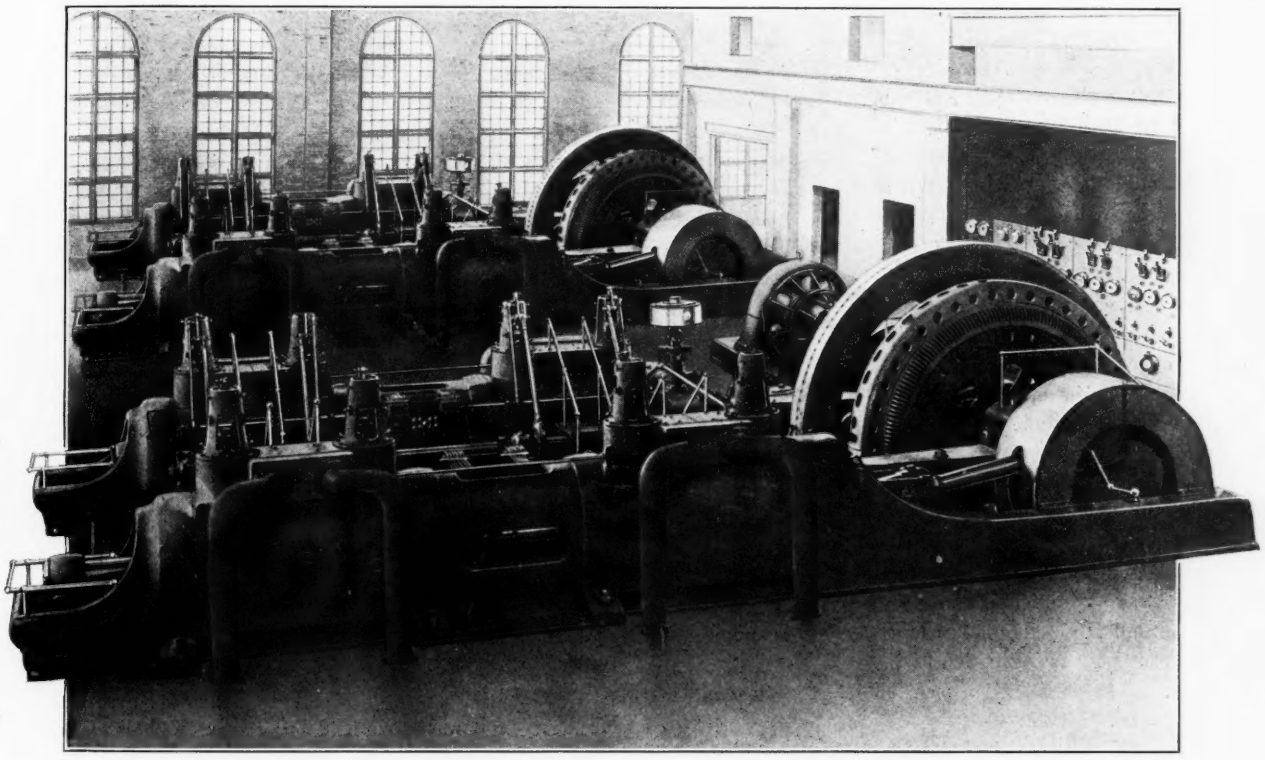
THE MILWAUKEE NORTHERN RAILWAY.

On October 28 the Milwaukee Northern Railway, one of the best-constructed lines in the West, sent the first cars over its tracks from the town of Cedarburg, nineteen miles north of Milwaukee, into the city on a regular hourly schedule, and a few days later the entire road was in operation as far as Port Washington. This system, which has Milwaukee as its southern terminal, is designed to bring Port Washington, Sheboygan, Fond du Lac, West Bend and numerous other towns and villages into closer communication with the metropolis of the state; and the district thus thrown open to traffic is extensive, rich and populous. Milwaukee merchants, through the agency of the new road, are placed directly in touch with fully 100,000 people more than those whom they have hitherto supplied, and, in addition to the places above mentioned, constant and rapid communication is established between this large central market and the towns of Thiensville, Grafton, Cedar Grove, Barton, Kewaskum and Campbellsport, as well as the rural communities lying between and adjacent to them.

Except for the short distances in the centres of some of the larger towns, the Milwaukee Northern road bed is located on its own right of way. The general absence of grade crossings and curves is a feature which goes far to insure safety from accident and to permit of a high-speed schedule. Where the right of way crosses the Chicago & Northwestern and the Chicago, Milwaukee & St. Paul Railroad tracks, subways, steel bridges with masonry abutments or viaducts are used. Just south of the depot at Port Washington the line runs under the Chicago & Northwestern Railroad through a subway spanned by a steel and concrete bridge; and that road is similarly crossed about a mile and a half from the Milwaukee city limits. A viaduct of steel 765 feet long has been built over the St. Paul tracks at Grafton and another of 654 feet long in the town of Mequon, about four miles south of Cedarburg.

A feature of the equipment of the Milwaukee Northern Railway which has attracted attention is the fact that the motive power of the road is furnished by gas-engine-driven electric-generating units of a size heretofore unknown for purely traction service.

The location of the main power plant is at Port Washington, on the harbor front, where the handling of coal, unloaded directly from Lake Michigan steamers at the company's docks is very economical and convenient. Two buildings comprise the power plant proper, one for the producers and one for the engines, generators, switchboards and protective apparatus. Both structures are of concrete, steel and brick construction and placed approximately fifty feet apart. The gas-supply main is run outside of and along the entire length of the power-house from the producer plant.



Allis-Chalmers Gas Engines and Generators Installed at the Plant of the Milwaukee Northern Railway, Port Washington, Wis.—Rated Capacity, 1,000 Kilowatts Each.

The generating units are three in number, each rated at 1,000 kilowatts, two of which are now installed; the third will be set up shortly. Each unit consists of a twin tandem horizontal double-acting Allis-Chalmers gas engine, direct connected to a 405-volt, twenty-five-cycle Allis-Chalmers alternator. Although the rating of each unit is given as 1,000 kilowatts, both engine and generator were designed with large overload capacities, the engine being capable of developing upward of 2,000 horse-power and the generator having a corresponding capacity. Each engine has four cylinders, thirty-two inches in diameter by forty-two-inch stroke, and will operate at 107 revolutions a minute.

The valve gear is of the standard Allis-Chalmers cut-off type and the engine operates with constant compression, thus tending to insure smooth running under the highly variable loads to which it is subjected. The inlet gear is extremely simple, consisting of a main inlet valve of the single-beat poppet type, eccentric operated, thus insuring long life and quiet running. The mixture of the air and gas is thoroughly effected before entering the cylinder, by means of an annular mixing chamber located under the main inlet bonnet; the design and operation of this device are such that, at the instant of closing of the main inlet valve, there is practically no explosive mixture left outside the cylinder. The gas valve is of the double-beat poppet type controlled by a variable lift-rolling lever operated by a single-link connection to the main inlet gear, the lift of the valve, and consequently the amount of gas admitted and the time of admission being regulated by the governor. The exhaust gear is of the single-beat poppet-valve type, eccentric operated, and is in this respect a duplicate of the main inlet gear. A feature of this gas engine is the location of the exhaust bonnet with its valve at the bottom of the cylinder, where all the dirt is removed by the action of the exhaust gases and the provision of a substantial jack to lower the entire exhaust mechanism out of place to allow inspection and regrinding of the valve, and which also serves to swing the valve chamber, with the valve and its entire operating mechanism complete, out to one side, where it can be reached by the crane hoist. The removal of one pin, either in the inlet or exhaust mechanism, is all that is necessary to allow the removal of either the inlet or exhaust bonnets, with their valves and entire operating mechanism, without disturbing any adjustment whatever.

The igniters are electrically controlled and so arranged that the time of ignition may be regulated by a single hand-wheel. Direct current, at 60 volts, is used in the ignition system. Duplicate igniters are provided at each end of the cylinder to insure prompt firing of low-heat value gases and also to avoid the chance of a shutdown due to short circuit. The entire ignition system, from the motor-generator set, which furnishes the current, to the electrically operated igniters, is solidly built.

The air starting device for the engine

consists of a small poppet inlet air-valve at each end of each cylinder, with a main distributing valve operated by the lay-shaft. Air is admitted to each cylinder in turn at what would be the explosion stroke. As the high compression carried prevents the engine from stopping on the dead centre, this arrangement insures the prompt starting of even a tandem engine without the use of a barring gear. The Port Washington engines, being twin tandem, will, of course, start from any position.

The engines are exceptionally heavy and rigid, the weight being concentrated in the frame cylinders and tie pieces in the direct line of the stresses to which an engine of this kind is subjected.

The load at the present time is extremely variable, swinging from less than one-half to fifty per cent overload, with momentary peaks greatly in excess of this. It is only by a study of the switchboard instruments, however, that this is apparent, as the engine handles the maximum overloads quietly, and with the same freedom from vibration that characterizes its operation under normal conditions. To the observer there is no outward indication of the magnitude of the forces at work. The engine turns its centres as quietly as a slow-running Corliss engine, and is as indifferent to the rapid changes in load.

All wearing surfaces, including the main bearings, slides, crank and cross-head pins, are arranged for a continuous oiling system and the cylinders are lubricated by carefully timed admission of the cylinder oil, Richardson's sight-feed oil pumps being used.

The water-cooling system includes ample provision for cooling the cylinder walls, cylinder heads, pistons, piston-rods, exhaust valves and exhaust bonnets. Water is circulated by means of two Norris and two Deming pumps, each driven by an Allis-Chalmers induction motor.

The gas for the engines is furnished by producers operating on the well-known Loomis-Pettibone system. The present installation comprises two generating units, each consisting of a pair of gas producers connected to a common economizer, wet scrubber and exhauster. The gas is delivered into a holder of 30,000 cubic feet capacity. The nominal rating of the present plant is 4,000 horse-power, and it has a capacity of twenty-five per cent overload for five hours' duration.

The brick building containing the apparatus is divided into a basement nineteen feet in depth and a single story about fourteen feet in height to the eaves. The operating or charging floor is about six feet above the level of the ground outside the building. A coal tank fifty feet long is located on the operating floor, with openings in front of the charging doors of the gas producers, thus bringing the fuel to points convenient to the man operating the gas plant. Hocking Valley bituminous slack coal, containing about 11,500 British thermal units per pound, is the fuel ordinarily used.

The plant is operated on the down-draft principle, the air being admitted through the charging door at the top of each producer, and the necessary suction being caused by an exhauster located beyond the wet scrubber. By this method the volatile matter and distillates are drawn through the deep bed of incandescent fuel and gasified, thus avoiding any tar-extracting machinery and enabling the system to produce gas containing eighty per cent of the heat units possessed by the fuel used. Reverse runs of steam, generated by the gas passing through the economizer, or waste-heat boiler, are occasionally made for the purpose of breaking up the fuel bed. The water gas made by this process mixes with the producer gas in the holder and slightly enriches it. The average calorific value of the gas as delivered from the holder is 125 British thermal units per cubic foot. The gas mains leading to the engines are equipped with Ludlow valves.

The electrical features of the equipment may be briefly described as follows: Three-phase current is generated in the power-house at 405 volts and 3,000 alternations by direct-coupled alternating-current generators, each of 1,000-kilowatt normal capacity. These machines are of a special type developed by the Allis-Chalmers Company for use with gas engines.

The laminated stator core is held in a heavy box yoke designed to allow full circulation of air around all parts. The core punchings are held in place by means of dove-tails and the armature windings are placed in open slots in the inner periphery of the stator core. The coils are held firmly in place by wedges and, on account of the open-slot construction, can be readily replaced in case of damage. dove-tails and the armature windings are spider and so arranged that they can be removed; the exciting coils are of copper strip, edge-wound.

The revolving fields are of special construction. The field-poles are of solid cast steel and are bolted to a heavy cast-iron spider; they can be readily removed in case it is necessary to get at a field coil. The field-windings are held in place partly by the projecting pole-tips and partly by brass rings running completely around the rotor on each side and fastened to the tip of the poles by long brass screws. This construction, combined with the solid poles, gives a large damping effect, prevents hunting and aids in securing parallel operation.

These generators will deliver their rated output of 1,000 kilowatts continuously at ninety per cent power-factor with a rise in temperature not exceeding thirty-five degrees centigrade; and fifty per cent greater current for two hours following a full-load run, with a temperature rise not exceeding fifty degrees centigrade. Current for excitation is furnished by two fifty-kilowatt 120-volt direct-current generators, driven by vertical gas engines.

The current from the main generators is delivered to a six-panel switchboard, having three generators, one exciter and two transformer panels, which contain all the necessary switches, circuit-breakers and instruments for properly handling and regulating the equipment.

From the switchboard the current is carried to the step-up transformers and also to the rotary transformer switchboard. There are seven Allis-Chalmers transformers of 500-kilowatt rating each, arranged in two banks of three each, with one held as a reserve. These transformers raise the voltage from 405 to a maximum of 22,000, with intermediate taps to allow the voltage to be varied if desired.

The current is carried from each bank of transformers to the high-tension bus through three oil switches of forty amperes' capacity each; and, in addition, two plug switches at each transformer to allow for speedily cutting out any transformer in case of breakdown. From the high-tension bus three transmission lines are led away, each with automatic oil circuit-breakers of forty amperes' capacity in circuit. The station apparatus is protected from lightning by means of an equipment of low-equivalent lightning arresters and oil-immersed choke-coils connected with the high-tension bus.

For supplying nearby portions of the

line, two 300-kilowatt rotary converters are provided in the main station. These are of standard Allis-Chalmers design. They have six poles and run at 500 revolutions per minute, taking three-phase alternating current at 405 volts and delivering direct current at 650 volts.

The converters are connected to a six-panel switchboard having two alternating-current rotary panels, two direct-current rotary panels and two direct-current feeder panels with two feeder circuits, which contain all necessary switches, circuit-breakers and instruments for handling and regulating the current and apparatus. The converters are protected from lightning by means of arresters on each feeder circuit.

There are eight substations, located at the following points along the right of way: Burleigh, Cedarburg, Georgia avenue, Marblehead, Brown Deer, Cedar Grove, West Bend and Campbellsport, two of which have each 400-kilowatt, 650-volt rotary converters and six 125-kilowatt 22,000/405-volt step-down oil-cooled static transformers. The remaining six substations each have two 350-kilowatt, 650-volt rotary converters and six 100-kilowatt, 22,000/405-volt step-down oil-cooled static transformers.

Each substation is protected against lightning by means of three 22,000-volt low-equivalent lightning arresters and auxiliary apparatus; each substation has an eight-panel switchboard, having two alternating-current rotary panels, two alternating-current starting panels, two direct-current rotary panels and two feeder panels, except in the Cedarburg substation, where there are three feeder panels.

All substations have 22,000-volt, twenty-ampere automatic oil circuit-breakers on outgoing transmission lines and on the transformer circuits, except at Cedarburg, which has forty-ampere breakers on outgoing transmission lines. The Cedarburg substation has also 22,000-volt, forty-ampere oil switches on the incoming transmission lines and three 2,000-volt, twenty-ampere automatic oil circuit-breakers in the high-tension equalizing bus.

The low-tension cables are triple braided, weatherproof wire supported on insulators, the insulated covering being relied upon only for protection from accidental contact and as a spacer. All high-tension wires are bare, mounted on suitable insulators.

The present rolling stock consists of eight heavy interurban cars of the type known as the "Semi-Empire Pullman," built by the Niles Car Manufacturing Company, of Niles, Ohio. They are handsomely upholstered, commodious and fitted with every means of comfort and convenience, including toilet room, electric heaters, overhead bundle-racks, coat-hooks and lamps of high candle-power. These cars, which have seating accommodation for fifty-two passengers, are fifty feet four inches in length and eight feet ten inches in width over all. Cars weigh, including trucks and motors, 70,000 pounds, and there are two seventy-five horse-power motors on each truck. The wheel base is six feet eight and one-half inches. The schedule speed is twenty-five miles an hour, including stops, with a possible maximum speed of fifty-four miles an hour. The wheels are thirty-six inches in diameter. The cars are equipped with straight air-brake equipments manufactured by the Allis-Chalmers Company, including the latter's new Type "OB" pneumatic governor and Type "J" emergency valve. At the forward end of each car is a spacious smoking compartment, and, partitioned off from this, directly behind the motorman, there has been left a space for trunks and express packages.

The cars used in the local service within the city limits of Milwaukee are duplicates of the ones used in the city of Detroit, with open rear platforms divided by a railing. These cars are equipped with forty-horse-power motors. The cars are forty-one feet long and eight feet five inches wide, and have rattan seats placed crosswise. They are single-ended, with the motorman's vestibule entirely segregated from the platform. Each of these cars is equipped with air-brakes. There are eight of these cars provided. The regular service will call for four in operation, maintaining a fifteen-minute headway. Schedule speed within the city of Milwaukee will be about ten miles an hour.

The total initial trackage is thirty miles long, while the line still to be completed will have 112 miles of track. The right of way is sixty-six feet in width and, except in the limits of the towns along the route, is owned by the Milwaukee Northern Company.

The type of rail used is the American Society of Civil Engineers' standard, seventy-pound "T," outside of cities, and Pennsylvania Steel Company's seven-inch, ninety-five-pound "T" in cities. The rail bonds are soldered in the web of the rail under the standard six-hole angle bars used to join the rails.

The road-bed is ballasted with gravel, using 3,000 yards to the mile. Cedar ties are used on the straight-line construction and oak ties for the curves. Cedar poles, with side-arm construction, are used on the private right of way, and wrought-iron posts, with span construction, are used in the cities. The spans are 105 feet long on straight line.

Telephone wires are also strung along the right of way, and communication with stations can be opened directly from any car by means of a pole-and-hook connection, on the Stromberg-Carlson system.

Mileage is offered in series of 1,000, 500 and 100-mile books, fixing the minimum fare at one and three-tenths cents a mile for the 1,000-mile books. The highest charge made is a cash fare of two cents a mile, and cash-fare receipts are redeemable at any ticket office for ten per cent of their value, if presented in five-cent units. Depots are provided at all of the chief towns on the right of way in connection with substations built of brick, steel and concrete. Shelters will be provided at all highway crossings from which cars can be signaled, and these highways are numbered consecutively and plainly indicated by signposts. The company has provided car barns and repair shops at Cedarburg, substantially built of brick and steel, the equipment of which is thoroughly modern. Additional car sheds are now being erected in the city of Milwaukee for rolling stock used in light service. One of the provisions in the franchise granted by the city of Milwaukee to the Milwaukee Northern Railway stipulates that three-cent fares shall be granted within the city limits of Milwaukee on the city cars. It is provided, however, that a cash fare on both city and interurban cars shall be five cents, and that the company shall sell strips of tickets, eight coupons to the strip, for twenty-five cents, good only on the local city cars, making the cost of each ride three and one-eighth cents. These tickets are being sold by the company at its stations, as well as by conductors on the cars.

Comstock-Haigh-Walker Company, of Detroit, engineer and contractor, has had complete charge of the designing and building of the system, under the direct supervision of F. W. Walker as engineer.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

The Place of the Laboratory in the Training of Engineers.

A discussion is given here by Professor A. L. Mellanby of the difficulties of laying out a technical engineering course satisfactory from all points of view. He points out the difficulty of getting the most out of such courses if the students have had no practical experience. On the other hand, if the man goes into the shop after leaving school, and before taking his technical course, he is apt to neglect his studies and not be prepared to go on with the higher education after he has had some practical training. A method he suggests is to send the man to his technical school for one year, then put him in the shop for three years. In this way he will have completed the mathematical training necessary and gone far enough into his science to enable him to keep up his studies beneficially. It is advisable, however, that during this time he be permitted to attend night-school or afternoon classes. After about three years of this training, he should then return to college and complete his professional education. One advantage resulting from such a system would be the increased usefulness of the engineering laboratory. This could then be made, in fact, a research laboratory, as the students would be competent to carry out work of actual value, and the laboratory would become of much more usefulness to the community.—*Abstracted from the Mechanical Engineer (London), November 23.*

Aluminum as a Substitute for Copper for Electrical Transmission Purposes.

An examination of the suitability of aluminum as a substitute for copper for electrical conductors is concluded here by J. B. Sparks. Taking up first high-tension cables, he gives the cost of these in the form of curves, which show that at very high voltages the cost increases with decreasing sections of the conductor on account of its increasing curvature. He also shows that, in low-tension single-core cables, whatever section of core be considered, the price per ton of aluminum corresponding to a given price per ton of copper is always the same, and that for a given price of aluminum wire per ton the cost of copper would have to be considerably higher for high-tension cables than for low-tension cables in order that the aluminum cable may be the cheaper. There is one exception to this conclusion, that of a very high-tension small copper section cable, which on account of its sharp curvature, requires extra thickness of insulation. In general, however, high-tension cables of copper are cheaper than those of aluminum. This difference may be increased when the cost of laying the cable is taken into consideration, as the larger aluminum cable may necessitate a larger duct. For overhead high-tension lines, the insulation cost disappears, but the cost of towers must be considered. This the author does by computing the costs of various lines and deducting from them the costs of the conductors. For a given conductivity, the aluminum conductor is lighter, but, on the other hand, its increased cross-section gives rise to increased wind strains, and the greater sag necessary may demand a higher tower. For this reason the costs of the towers should be about equal. The author finds that, for larger sections, the aluminum lines are cheaper, while for smaller sections the copper line has the advantage on account of the less sag. He concludes that when the price per ton of aluminum wire is just about double the price of copper wire, an aluminum overhead line would cost about the same as a copper line; and if an aluminum line is cheaper than copper for equal conductivity, it will usually be the more economical. He next considers the skin effect, and inductance and capacity of the line. An aluminum conductor, due to its larger size, will have an increased capacity, but a decreased inductance, as compared with copper. The differences are about equal, but the balance is in favor of the aluminum line, since, in general, the inductance of a line is greater than its capacity. The skin effect is directly proportional to the section of the conductor and inversely proportional to the conductivity, and hence for equal conductivities it is the same for all solid conductors. The conclusion is that aluminum may be expected to compete with copper in low-tension cables, but not in high-tension, three-core cables, and it has every chance of becoming more widely used than copper for overhead work.—*Abstracted from the Electrical Review (London), November 22.*

The Wehnelt Cathode in a High Vacuum.

It has long been known that a good vacuum can be made into a good conductor by the use of an incandescent cathode, and Wehnelt has shown that if this cathode be coated with one of the alkaline earths, surprising results can be obtained, as currents as large as two or three amperes per square centimetre of cathode surface may be passed through the vacuum, the fall in potential at the cathode being practically negligent. While studying this phenomenon, Frederick Soddy noticed an unusual behavior which he here describes. The cathode had an area of one square centimetre, and in the same tube was an anode of calcium, which metal absorbs practically instantaneously and very perfectly at its volatilizing temperature all known gases with the exception of the argon family. It was found that when a good vacuum had been obtained with this arrangement and a current from a 250-volt supply passed, in order to heat the anode, bringing the latter up to its volatilizing point, the current was interrupted suddenly and completely. After a short while a feeble glow appeared intermittently, but was not sufficient to move the ammeter needle, which had previously registered 1.2 amperes. A current could at this time be passed from the hot cathode to a third electrode as anode, but this did not cause any appreciable resumption in the current in the 250-volt circuit. If more gas was set free by heating the third electrode, the current in the main circuit resumed its original intensity, heating up the calcium anode when the phenomenon was repeated with a sudden cessation of current. The whole phenomenon could be repeated by admitting oxygen into the apparatus and proceeding as before. The author believes that this experiment

shows that, in a sufficiently high vacuum, the Wehnelt electrode ceases to be effective. He also calls attention to Richardson's statement that in a similar Wehnelt tube, the current passed was twenty-five times the maximum value obtained by supposing each molecule to produce one ion; so that it was highly improbable that any considerable portion of the conductivity was due to ions liberated from the electrode. The author agrees with this statement, as he does not think that the electric emission can account for more than a negligible fraction of the total current, which is therefore carried almost wholly by the residual gas. This view is in agreement with the experiment just described, in which the absorption of the gas caused an entire interruption of the current.—*Abstracted from Nature (London), November 21.*

A Standard of Mutual Inductance.

The most important conditions governing the design of a standard of mutual inductance are that it must be accurately calculable from the geometrical dimensions, as permanent as possible, and of a value sufficiently large to give high sensitiveness. In addition to these it is desirable to keep the resistances of the parts as low as possible and to avoid the occurrence of eddy currents, and also of capacity effects between the primary and secondary circuits. To carry out these conditions a coil has been designed by A. Campbell, who here gives the mathematical analysis of the design and describes how it was carried out. To meet the conditions outlined it is desirable that the distance from the primary circuit to the secondary should, at all points, be relatively as great as possible. To determine the best arrangement, the mutual inductance of a number of arrangements of coils of different diameters and different distances apart has been computed, and the results plotted as curves. These show that when only two coils are used the distance apart at the centre should be relatively large, or else zero; the latter condition is desirable only when the radii of the two coils are equal. When the distance apart is large, a two-coil arrangement must be bulky to give a sufficiently large value of a mutual inductance. For these reasons this type of design is not so good as one in which there are three coils all coaxial, the two outer coils being placed equally distant from the centre one. With this arrangement a value for the radius of the secondary coil may be selected which gives a maximum value of mutual inductance and which varies but slightly for small variations in the radius, or for small axial displacements, so that slight errors in these two quantities will produce but small errors in the result. Moreover, a value for the distance apart of coils may be selected which will cause the mutual inductance for each turn of the secondary coil to be practically constant, so that the secondary may consist of a many-layered coil whose dimensions and position need not be known with any high accuracy. In this way the burden of accuracy is thrown on the two outside primary coils, which, in the calculation, have been assumed to be mere circles. The best design for these coils is to make them two coaxial helices of equal and finite length, the secondary to be placed midway between them. This method of construction was followed in making a standard coil for the British National Physical Laboratory. In this case the two primary helices are of bare wire (seventy-five turns each), wound on one marble cylinder thirty centimetres in diameter. The secondary coil consists of 488 turns in a channel of one square centimetre section with a mean diameter of 43.8 centimetres. The nominal value for this is close to ten milli-henries. —*Abstracted from the Electrician (London), November 22.*

Organization Problems in Steam Railroad Electrification.

The electrification of any considerable or important portion of a modern steam railroad is a task of greater magnitude than is generally appreciated. The selection of a suitable equipment, in the face of the progress being made to-day, is in itself a difficult question, while the maintenance of unimpaired service during the transition period is a monumental task. The adjustment of the working force to the new conditions, the modification in records, and the creation of a new system of reports to meet the altered situation, the proper installation and adjustment of the power plant; the transmission, distribution and rolling-stock equipment and the protection of the traveling public, throw an enormous burden and responsibility upon the railroad company, which can be carried only by a carefully developed organization of trained men. In this article H. S. Knowlton studies the various conditions brought about by the change from steam to electricity and points out how the problem may be advantageously solved. At the present stage of electrification in the steam railroad field, it is not feasible to present any detailed organization diagram generally applicable. Each case presents peculiarities of its own. However, it is important to realize how profoundly a change in motive power modifies present conceptions of railroad practice. The change from steam to electricity means a revolution in transportation methods, both from the standpoint of the railroad and from that of the public. No part of this work should be relegated to a contractor. Where the work is large or important this officer should be able to give his entire time to it. He should be empowered to build up a new organization to solve the various problems connected with the installation of the new system. These problems can not be handled by the old staff, for they are almost entirely peculiar to electric service. It is advisable, early in the work, to get out instruction books for the train service employés. The character of the equipment will influence the form of the organization to a large extent, but in any event, it calls for an entirely new branch of the operating department to take care of the power-house and line employés. Another new branch of the operating department must be a group of electrical inspectors for the rolling stock and a force for making repairs to the electrical equipment. There is so little in common between an electric and a steam locomotive that the old shop force would not be competent to handle the new work. Experience shows that the train service must remain under the jurisdiction of the general superintendent, but it is not clear what the final place of the electric power and maintenance forces shall be. In a general way, the head of the engineering department will presumably be in charge of the operation of the power-supplying system and of the maintenance of electrical rolling stock; construction matters may also be under his jurisdiction. The purpose of the new engineering organization must be to solve those problems which could not be solved by the existing steam railroad organization, and to cooperate with the regular operating department so as to give good service, to secure economies in routine operation, and to analyze dail the conditions, with a view toward improving the equipment and methods for the benefit of future extensions.—*Abstracted from the Engineering Magazine (New York), December.*

Methods of Getting New Business

A DEPARTMENT DEVOTED to the COMMERCIAL DEVELOPMENT of CENTRAL STATIONS

Managers are Invited to Contribute Suggestions for Methods of Increasing the Demand for Electric Service

EDITED BY CHARLES A. PARKER.

Methods of Getting New Business at Fond du Lac, Wis.

Up till January, 1906, the Eastern Wisconsin Railway and Light Company, of Fond du Lac, Wis., made but little effort toward securing new business. The lack of hustle was seriously felt in the ever-increasing number of gasolene lighting installations. In fact, to such an extent was this the case that it was found advisable to arouse material interest in favor of this company, as well as electricity in general.

Mr. N. C. Draper, whose picture appears above, is vice-president and general manager of the Eastern Wisconsin Railway and Light Company, a concern whose modern and aggressive business methods have brought about a wonderful increase in the use of electricity in Fond du Lac, Wis., both for lighting and power purposes. When Mr. Draper first took charge of the business of this company the main street of Fond du Lac was a dark and dismal spot after the sun went down, but all is quite different now. Mr. Draper's energetic and progressive methods have worked wonders. As manager of the force of the Peoria & Topeka Electric Railway Company, Mr. Draper first entered the central-station field. From 1900 to 1904 he was with the Quincy Gas and Electric Company, Quincy, Ill., after which time he entered the employ of the Westinghouse Electric and Manufacturing Company as traveling salesman. Going back once more into central station work he entered the Eastern Wisconsin Railway and Light Company as vice-president and general manager. It is little wonder that this concern should make its influence so forcibly felt with a man of Mr. Draper's calibre at its head. He is of a very pleasing personality, and every one who comes in contact with him feels that he is one who would be a warm friend to those who wished to make a friend of him. Consumers of this company are made to feel the strength of Mr. Draper's personality, and feel absolutely assured of a square deal in all their dealings with the Eastern Wisconsin company. From the standpoint of a business man and a gentleman, Mr. Draper is a marvelously strong head.

To start the ball a-rolling the management decided to hold an electrical show at which electrical appliances were demonstrated to the public. This electrical show was followed up by a systematic campaign of direct-by-mail advertising to a carefully compiled list of prospective customers. This advertising was found to be extremely effective, because it reached only such people as the company desired as customers.

Newspaper advertising was employed with good results in keeping the company's name before the public. But this was not all—the advertising was not left to do the work alone, but was backed up forcibly by thorough solicitation, with the result that the ice was soon broken, and the company not only succeeded in getting back the business it had lost, but put on enough new business to double the output in one year.

THE PAST IS DEAD
PROGRESS has sounded the knell of kerosene, gasoline, scary time and other old forms of incompetent illumination.
Are you ready to quit them?
Haven't you tolerated them long enough?
There was a time when burning pitch fagots furnished the only means of artificial illumination folks knew about, and it was considered sufficient.
Then came the tallow dip, and everybody discarded his pitch fagot in disgust.
The tallow candle was next to exert its supremacy over the tallow dip, and folks were glad.
Is Your House Wired?
THE ELECTRIC FLAT IRON
The Story of Mrs. John Higgins' Electric Home and Her Electrical Servant
TO-DAY IS NOW.
ON OUR BOOKS

Illustrations showing a series of the effective folders, booklets, letters, etc., used by the Eastern Wisconsin Railway and Light Company, Fond du Lac, Wis., for the purpose of educating the public and customers. These pieces of advertising are extremely attractive and are being used to splendid advantage. The management of the Fond du Lac company asserts that it would be greatly handicapped without this class of advertising.

SIGN AND STORE BUSINESS.

Signs, in most instances, are run on a flat rate at a sliding scale of charging, which brings in a net revenue of from six to eight cents per kilowatt-hour. Most of these signs burn for four hours per night, and are turned on and off by the company's patrolmen.

Especially designed mailing cards, elaborate folders, artistic booklets, letters, etc., are mailed monthly, keeping the prospective customers, as well as those already secured, fully enthused over the advantages of signs and well-lighted store windows as advertising assets.

Until the present management took control, which was but a short time ago, there was one electric sign in the city, and that one sign was lighted only on Saturday nights. In fact, the business

Mr. J. B. Lindl, late of the Madison Gas and Electric Company, is now superintendent of lighting and power of the Eastern Wisconsin Railway and Light Company, of Fond du Lac, Wis. Previous to Mr. Lindl's engagement with the Madison Gas and Electric Company he occupied a post as meter reader and collector for the Fond du Lac company. His ambition for success in central station work suggested a broader knowledge of the business and a more thorough technical understanding of affairs. He therefore took up a study of these technicalities with the International Correspondence Schools, with the result that he was promoted shortly after to the commercial department, having been made contract agent and given charge of this department. But ambition would not let him rest, and as a more attractive offer was made by the Madison Gas and Electric Company, he went with this company as advertising manager, and three weeks after was promoted to the commercial managership. However, in July of this year, he resigned this position for that which he now holds as superintendent of the Eastern Wisconsin Railway and Light Company. Due to the combined efforts of Mr. Lindl and the management of this company some radical changes and profitable improvements have been made. This hustling young man has kept everlastingly at it, with the result that his department is one of the most progressive and up-to-date that can be found in any central station in this country. Mr. Lindl's education and actual experience in the field have made him a most valuable asset of the Eastern Wisconsin Railway and Light Company.

place that was electrically lighted was a notable exception, and gasolene held high carnival. All this has been changed, as aggressive business methods have made Fond du Lac one of the best electrically lighted cities in Wisconsin.

RESIDENCE BUSINESS.

The company finds that the very best advertising that can be used in the residential district is the monthly bulletin. It employs this means, and has given this very appropriate name to its publication—"Electrical Booster." This is mailed monthly to customers and also the best prospective customers on the pole lines.

The "Electrical Booster" serves a double purpose for this company, for not only does it carry the electrical message to the home, but the opportunity is grasped to educate the business man to the advantages of electricity for business places.

POWER BUSINESS.

Every two weeks the prospects of the company receive, through the mails, a bright, up-to-date, well-designed and well-written advertisement. One week an illustrated letter is mailed, another week a booklet, etc., etc. This advertising is far above the ordinary. The management realizes that manufacturers receive such an abundance of advertising matter through the mails that only the most attractive will be given attention, and makes sure of pinning the prospect's attention by making sure of the advertising.

The estimate herewith produced of the Sweet Wagon Works is similar to the data regarding size of machines, speed, etc., that were secured from each plant in Fond du Lac.

The data from the Sweet Wagon Company were worked up and tabulated, thus establishing the cost of installation. Next the number of hours run for each machine was ascertained and an estimate

ESTIMATE OF EQUIPMENT AND POWER FOR THE SWEET WAGON WORKS.

MOTORS REQUIRED FOR INDIVIDUAL DRIVE.

Machine.	Speed R. P. M.	Type Motor.	H. P.	Speed R. P. M.	Cost.
Circular saw	1,600	S	5¼	1,600	$125 00
3 grindstones		R	1½	1,275	58 00
1 mortising machine	850	S	4	1,280	124 00
1 jointer	4,000	S	5¼	1,600	125 00
1 planer	3,000	S	5¼	1,600	125 00
1 large band saw	350	R	5	975	140 00
2 small band saws	450	R	3½	1,100	118 00
	450	R	3½	1,100	118 00
1 circular saw	750	S	3	2,000	92 00
1 tenoning machine	750	S	3	2,000	92 00
1 double shaper	750	S	4	1,280	124 00
2 sanders	1,400	S	4	1,280	124 00
	530				
1-5 spindle drill	300	R	2	1,325	88 00
2-1 spindle drills	1,200	R	½	1,375	45 00
	1,200	R	½	1,375	45 00
1 riveting machine	120	S	2	1,425	92 00
1 wheel reaming machine	2,000	S	5¼	1,600	125 00
Group drive for machine shop		S	10	1,200	218 50
Total			67½		$1,978 50

ESTIMATE OF POWER REQUIRED UNDER AVERAGE OPERATING CONDITIONS.

Machine.	Hrs. Run per Day.	Hrs. Run per Mo.	H. P. Hrs. per Day.	H. P. Hrs. per Mo.	K. W. Hrs. per Day.	K. W. Hrs. per Mo.
Circular saw	5	130	26.25	682.50	19.882	509.145
3 grindstones	1	26	1.50	39.00	1.119	29.094
1 mortising machine	6	156	24.00	624.00	17.904	465.504
1 jointer	3	78	15.75	409.50	11.749	305.487
1 planer	5	130	26.25	682.50	19.582	509.145
1 large band saw	2	52	10.00	260.00	7.460	193.960
2 small band saws	2	52	14.00	364.00	10.444	271.544
1 circular saw	3	78	9.00	234.00	6.714	174.564
1 tenoning machine	6	156	18.00	468.00	13.428	349.128
1 double shaper	3	78	12.00	312.00	8.952	232.725
2 sanders	8	208	32.00	832.00	23.872	620.672
1-5 spindle drill	3	78	6.00	156.00	4.476	116.362
2-1 spindle drills	3	48	3.00	78.00	2.238	58.181
1 riveting machine	2	52	4.00	104.00	2.984	77.578
1 wheel rimming machine	2	52	10.50	273.00	7.833	203.658
Machine shop group drive	4	104	40.00	1,040.00	29.840	775.840
			252.25	6,558.50	188.177	5,080.764

COMPARISON OF COST OF OPERATING WITH STEAM AND ELECTRIC DRIVE.

COST OF ELECTRIC DRIVE.

5,080.764 kw.-hours per month	$143 93
Oil, brushes, fuses, etc	10 00
Interest on $1,978.50 at 6 per cent per annum	9 89
Total cost per month	$163 82

COST OF STEAM DRIVE.

30 tons of coal at $4	$120 00
Oil, waste and repairs	15 00
Engineer's wages	60 00
Interest on steam plant and shafting estimated $1,500	7 50
Cost per month of steam	$202 50
Difference in favor of electric drive	$38 68
To this may be added value of marketable waste materials, say, ten loads of wood blocks at $4.	40 00
Total estimated saving	$78 68
Or, actual cost of electric drive	$123 82
Against cost by steam	$202 50

Submitted to Sweet Manufacturing Company by J. B. Lindl, superintendent electric light and power, Eastern Wisconsin Railway and Light Company.

In one year 200 houses were wired and connected to the company's lines, 500 flat-irons were installed, besides many other electrical utensils.

made of current consumed. Thus the cost of operating electrically was ascertained. Next a comparison was made between the respective costs of the steam and electric drives, which in nearly every instance showed a decided advantage in favor of electric drive. By working up power data in this form, the economical side of the prospect's nature is strongly appealed to, and one-half of the battle is won.

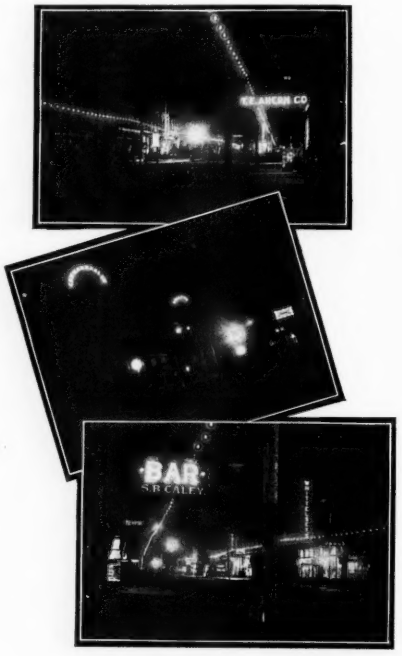
COOPERATION WITH THE ELECTRICAL CONTRACTOR.

In order to secure the cooperation of the electrical contractor, an offer was made of a commission of fifty cents for every new consumer secured and three cents per sixteen-candle-power equivalent in addition, a commission of fifty cents for each 500-watt flat-iron, fifty cents per horse-power for motors and fifty cents for every fan installed.

The company, by showing this spirit of cooperation with the electrical contractor, has a force of intelligent solicitors, which means greatly added strength to the commercial department.

It will thus be seen that the Eastern Wisconsin Railway and Light Company conducts a modern and aggressive new-business department in an energetic manner, and as all this has been done as a means to an end, let us look at the results.

Since 1906 the Fond du Lac company has increased the total horse-power installation from 208 horse-power to 610 horse-power.



Three views of Main street, Fond du Lac, the one-time "one-sign" street. Before the advent of the present management but one electric sign appeared, and that on Saturday night only. Note the difference as shown above. It is safe to say that there are few better electrically lighted cities in the state of Wisconsin than Fond du Lac.

There is little left to be said. Instances of this kind point to but one thing—the advantage of advertising judiciously and soliciting unremittingly. The grand field of electrcity is too broad to allow people to remain in ignorance of what it will do for them, and the company that willingly sits by, allowing competitive lighting and power companies to walk away with business which ought rightly to belong to it, to say the least, has not the modern spirit. The evidence which comes from all sides, and particularly from such companies as the Eastern Wisconsin Railway and Light Company, points a telling moral to those companies who have not modernized their central stations and organized a thoroughly up-to-date new-business department.

Aggressive companies who have learned the lesson that it pays to advertise can certainly take some pointers from the Fond du Lac company in the manner of handling customers. It is far more important to hold and satisfy a prospect who is really interested than it is to capture those who have to be made interested. This is one of the reasons why the Eastern Wisconsin Railway and Light Company has made its advertising such a success. It has given every attention to prospects, no matter how small and insignificant, who have intimated their interest in things electrical, and has succeeded in bringing the big majority to its way of thinking.

These are the cover designs of the October, November and December issues of the "Electrical Booster," published monthly by the Eastern Wisconsin Railway and Light Company, Fond du Lac, Wis. This publication is an elaborate one, printed in two or more colors on a fine quality of paper. Its sixteen pages are loaded with strong argumentative matter of the conversational order, sure to accomplish splendid results.

Pittsburg Branch American Institute of Electrical Engineers.

The Pittsburg branch of the American Institute of Electrical Engineers met Wednesday, December 4, in the lecture hall of the Carnegie Institute.

J. H. Schoeff, of the Westinghouse Electric and Manufacturing Company, abstracted A. H. Armstrong's paper, "Comparative Performance of Steam and Electric Locomotives," emphasizing important points in the paper. Among them was the fact that at higher speeds the electric locomotive develops comparatively more tractive effort than the steam locomotive; also that the electric locomotive figured better on mountain grades for hauling freight.

He estimated the time a steam locomotive is idle during the day, on account of standing in stations, at blocks, etc., and stated that on account of having to keep up steam all the time the steam locomotive lost, on an average, 400 pounds of coal an hour.

A. W. Gibbs, general superintendent of motive power of the Pennsylvania Railroad Company, in a written communication, pointed out some of the lines along which the steam-locomotive designer is working, saying in part as follows:

You should bear in mind that the present capacity of the steam locomotive is largely a question of the capacity of the fireman to stoke it adequately, and this is the principal reason why there is a prevailing feeling that the older, smaller locomotives were, proportionately, better than the modern large ones. The introduction of a mechanical stoker, which is probably a question of but a short time, will materially change this condition.

Furthermore, supposing an increase in the capacity of the road by whatever power is found most advantageous, this will still leave the choke at the usual place —the terminals. Moreover, the capacity of existing lines, especially double-track ones, is governed very largely by the presence on the line of trains having several rates of speed. While the use of a locomotive which will make high speeds with heavy trains will enable movements to be made which might not be made with a locomotive of slow speed, nevertheless what would most largely tend to economy of the movement is unification of the speeds. Finally, in considering the use of locomotives having sufficient power to maintain high speeds with heavy loads, it should not be overlooked that the construction of the electric locomotive as a vehicle which will maintain such high speeds without damage to tracks still requires attention.

Malcolm MacLaren, formerly of the British Westinghouse Company, discussed the subject of capacity limitations. He compared the 1,200-volt direct-current system with the alternating-current system, and showed that for some speeds and work the direct current was more economical, but on the whole thought the alternating-current the better.

W. Cooper, of the Westinghouse Electric and Manufacturing Company, discussed the subject from the control standpoint, particularly with regard to the braking of long trains on steep grades, and called attention to the fact that electric trains can be braked by means of electrical control, while on some steam roads great trouble is experienced from hot brake-shoes and wheels, the heat becoming so intense in some instances as to crack off the wheel flanges. He also pointed out how it was possible to run trains of practically any length by an arrangement of electric locomotives distributed through the train and controlled by one man.

N. W. Storer said that it was not practical for steam roads to change over all their equipment at once from steam to electric, but that it would pay to electrify a great many terminals and mountain divisions with steep grades. Upon one occasion he was snowed up in a Northern Pacific train for several days with very little to keep him warm. The principal trouble seemed to be the inability of the locomotive to keep up steam on account of the severe cold. He pointed out that if the train had been propelled by an electric locomotive no delay would have been experienced, as the colder the motors the more efficiently they work.

C. F. Scott called attention to the greater cleanliness of the electric locomotive. He also pointed out that all the limitations of the steam engine had been exceeded by the electric locomotive. He had just received word from Indianapolis that an electric locomotive was making a 586-mile run per day.

Public Service Commission to Test Electric Meters in New York State.

The Public Service Commission, Second District, state of New York, has announced that arrangements have been perfected for testing the correctness of the registry of electric meters. The charge for testing will be refunded to the applicant in case the meter proves to register more than four per cent too fast. All applications must be addressed to the lighting and power department of the Public Service Commission, Second District, Albany, N. Y. If the meter is rated at five amperes or under, $1 must be enclosed; if over five amperes, and not exceeding ten, $1.50; if over fifteen, and not exceeding twenty-five, $2.50; if over twenty-five and not exceeding fifty, $3. An extra charge of fifty cents will be made for each additional ten amperes or fraction thereof.

The state has been divided into four inspection districts, with John P. Geberlein, Brooklyn; Leo E. Northshield, New York city; F. W. Schiller, Utica, and A. C. Brown, Dannemora, as inspectors. The annual salary is $1,200.

Offer for Western Electric Stock.

A dispatch from Chicago states that the Western Electric Company has issued a circular to stockholders conveying an offer by the American Telephone and Telegraph Company to purchase their stock. The American Telephone and Telegraph Company now controls the Western Electric Company, but is said to be seeking to buy up all the shares. In order to accomplish this it offers for each $100 share of the Western Electric Company $250 in four-per-cent convertible bonds of the American Telephone and Telegraph Company, or it will pay $225 in cash. The telephone company reserves the right to pay either in bonds or cash. The stock is to be deposited with the Merchants' Loan and Trust Company on or before January 20, 1908, or at a later date to be agreed upon. The stock will be paid for on or before October 15, 1908.

Federal Civil Service Examinations.

The United States Civil Service Commission announces an examination on January 8, 9 and 10 to secure eligibles from which to make certification to fill two vacancies in the position of mechanical and electrical draftsman, one at $1,200 and the other at $1,500 per annum, in the office of the Chief of Ordnance, War Department, and vacancies requiring similar qualifications as they may occur in any branch of the service. Three days will be required for this examination. The age limit is twenty years or over on the date of examination, and the latter is open to all citizens of the United States who comply with the requirements. Applicants for this examination should apply at once to the United States Civil Service Commission, Washington, D. C., for application form 1,312.

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

Allis-Chalmers Lighting Transformers.

The Allis-Chalmers Company, Milwaukee, Wis., has placed on the market a line of lighting transformers designed for operation on 1,050 or 2,100-volt primary circuits. The company has made a notable record with its power transformers, which have been installed for years in various places throughout the country, with consistently successful results. The new line of lighting transformers has been built along the same lines as have made the power transformers so successful, and equally satisfactory service may be assumed.

NEW LINE OF ALLIS-CHALMERS LIGHTING TRANSFORMERS.

The lighting transformers are made in sixteen sizes, ranging from 0.6 kilowatt to fifty kilowatts. They are intended for lighting work on a normal frequency of sixty cycles per second, but can be operated on any frequency from fifty to 140 cycles, the efficiency being somewhat better on the higher frequency than on the lower. They can also be operated at ten per cent above or below normal voltage.

The transformers are of the so-called core type, the cores being made of the best quality of iron obtainable, and which has been especially selected for the purpose. The alternate laminations are varnished on both sides with a special varnish which, the company states, is unaffected by the oil in which the transformer is immersed. In building up the cores a duct is left between the laminations in all except the smaller sizes, providing passage for the circulating oil.

The coils are wound on two sides of the rectangular iron core, and the secondary is placed next to the iron. The primary and secondary coils are subdivided, and the coils are impregnated with insulating compound after they have been thoroughly dried out under vacuum. The insulation between the coils and core, and also between the primary and secondary coils, is prepared from fullerboard and mica. This insulation is approximately cylindrical, and has no sharp bends to cause weak points liable to break down.

The terminals of the high-voltage windings connect to a porcelain terminal block, allowing the primary coils to be readily connected in parallel for 1,050 volts, or in series for 2,100 volts. Changes in the secondary connections are made outside the case by joining up the leads to the secondary mains, so as to give the required series or parallel combination. Both primary and secondary leads are of flexible rubber-covered cable, treated so that it will not siphon the oil. The cables pass into the case through porcelain bushings, into which they are securely cemented.

For transformers from 0.6 kilowatt to fifteen kilowatts, the cases are of cast iron with removable cover held in place by eye-bolts. The larger sizes—from twenty to fifty kilowatts—have corrugated sheet-iron cases with cast-iron top and bottom. Each transformer is supplied with enough oil to grease the coils and core. This oil has been selected as the result of a great many tests on insulating oils, and it has a high flashing point and great dielectric strength. Each transformer is furnished with hanger hooks for cross-arm suspension. Eye-bolts or hooks on the transformer cases are also provided for convenience in handling and mounting on poles.

The copper and iron losses have been carefully proportioned to secure high all-day efficiency on lighting service.

Transformers of from three to fifty kilowatts' capacity can be operated on the three-wire system with unbalanced load.

The Bossert Utility Box.

The accompanying illustration shows the new utility box which has been placed on the market by the Bossert Electric Construction Company, Utica, N. Y. As may be seen from the illustration, this consists of a stamped-steel outlet box containing two knockouts in each side, two knockouts in the bottom, and one knockout in each end. Inverted lugs are formed on the inside edges of the utility box. These lugs are threaded to receive a small screw, which holds down the cover that may be used.

The New Bossert Utility Box.

The box can be employed in open work wherever an outlet or junction is required. It does away with a large stock of special fittings, as a number of covers may be supplied, adapting the box to new work where the particular type of fitting has not been decided upon, for pipe-conduit work having threaded entrances of different diameters, and also for molding work, when the box may be equipped with porcelain covers containing one, two or three outlets for standard drop cords.

Great Western Power.

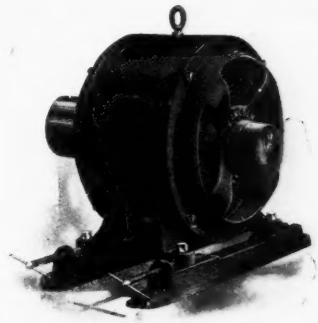
The Great Western Power Company, of California, has ordered from the General Electric Company the largest transformers known in the historv of the electrical industry. The total weight of each will be 128,000 pounds, of which 40,000 pounds is due to the 5,000 gallons of oil used in each machine for cooling and insulating purposes. Each transformer stands twenty feet above the floor and measures nine by eighteen feet. They will be used to transmit 40,000 horsepower at 100,000 volts 165 miles along the Pacific Coast from the Feather river development.

New Line of Induction Motors.

The Lincoln Electric Company, of Cleveland, Ohio, has lately placed on the market a new line of induction motors. These machines, while not differing radically in any particular detail from the usual design, are so well worked out that exceptionally good results are obtained. The claims made for these machines are: Excellent ventilation of the windings; low iron loss, especially in the stator laminations; very large bearings, which insure a long life.

The scheme for ventilation follows somewhat the usual arrangement found in direct-current apparatus. The iron on the outside of the stator laminations is open to the air, so that the maximum amount of radiating surface is directly exposed. Large openings along the shaft give the rotor-iron ample radiating surface. The coils are well distributed and are so placed that the maximum amount of surface is exposed for radiation. There is a space between the coils in each slot, which allows a continuous draft of air to pass from the rotor through the slots to the outside. Thus a continuous circulation of air is effected through all the windings of the machine.

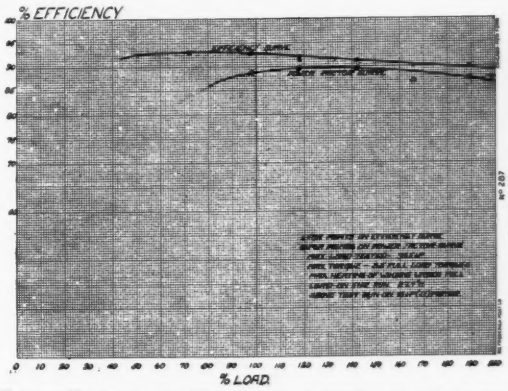
The iron loss is kept at a minimum in two ways; by using an especially good quality of iron and by working the metal at a low magnetic density. Since the iron loss per cubic inch per cycle varies as a power of the magnetic density, doubling the density at which the iron is worked increases the loss from three to four times, depending on the division of the loss between hysteresis and eddy currents. By this method of design the operating temperature is not the result of a scheme to get rid of the heat, thus keeping the machine cool by exceptionally good radiation, but instead heat is not produced, thus not only making the machine run cool, but also increasing the efficiency. These two features, low iron loss and good ventilation, are said to make the operating temperature of these motors very low, under continuous full load.



The Lincoln Induction Motor.

All induction motors, of necessity, have a short air-gap, and if this gap be not uniform about the rotor, the power-factor and efficiency will be lowered. Hence the bearings become a most important mechanical feature of the motor, and on the perfection of these depends the life and efficiency of the machine. The bearings of Lincoln machines have been constructed on the assumption that this feature of the design is the most important one from the user's viewpoint.

The plan used in the design was to make a large bearing and flood it with oil. The bearing area of the shaft on the sleeve is from one and one-half to two times as great as that usually thought ample, so that the pressure per square inch is reduced by a proportionate amount. The oil is carried up on the shaft by the usual



Power-Factor and Efficiency Curves of a Fifteen-Horse-Power Lincoln Motor.

ring oiling device. Distribution is effected by oil grooves which insure that all parts of the bearing are equally supplied. The journal itself is a cast sleeve of the best babbit metal, turned and reamed to exact dimensions. These bearings are carried in stock for all machines, so that if it at any time becomes necessary, because of wear or accident, to replace the sleeves, this can be done cheaply and with practically no loss of time.

The efficiency of these machines is good, largely because of the low iron loss, as is shown in the accompanying curves of efficiency and power-factor for a Lincoln fifteen horse-power 1,200 revolutions-per-minute motor.

Trade-Mark.

The accompanying design has been registered as a trade-mark by Frank B. Cook, the well-known manufacturer of telephone-protection apparatus, of Chicago. This trade-mark will be placed on all packages

New Cook Trade-Mark.

containing Mr. Cook's products, which include switchboard protectors, "U" bolts, guy clamps and wire joints. The trade name of Frank B. Cook has not been changed, nor has the address, which is 249 West Lake street, Chicago, Ill.

Electrical Supplies for the Navy Department.

The Bureau of Supplies and Accounts will open bids in Washington, D. C., on December 26 for the following electrical material: 700 yards lamp cord, miscellaneous electrical supplies and 18,000 feet of copper rubber and cotton-insulated wire for delivery at Boston, Mass.; 8,300 miscellaneous fuses, 150 combination desk and bracket fans, 100 pounds of uncut mica, 1,348 pounds of flexible and compressed plate micanite, 242 lengths of thirty-inch-long hard-rubber rods, miscellaneous red fibre, miscellaneous spare parts for enclosed arc lamps (form 12), thirty-five voltmeters and ammeters, miscellaneous platinum wire and sheet platinum, 625 pounds magnet wire and 165 pounds "Advance" resistance wire for delivery at New York city.

New Electrical Supply for Philadelphia.

It is reported that the Equitable Electric Power Company, which was recently chartered by the state of Pennsylvania, is making arrangements whereby it will be able to supply electric power in Philadelphia shortly, if the plans now being discussed are carried through. The plan is to secure power from the large power-house of the Philadelphia & Western Railroad Company, and it is said that the Keystone Telephone Company is interested in the scheme.

The arrangement to be effected between the railroad and lighting companies is expected to put the Philadelphia & Western Railroad Company upon a paying basis, thus utilizing to full capacity the large power plant erected along the line of the third-rail electric road at Cobb's Creek, opposite Beechwood Park, three miles west of the city. The plant has a capacity of 30,000 horse-power, of which only 500 horse-power is used in operating the road from the Rapid Transit terminal station at Sixty-ninth and Market streets to Strafford, eleven miles westward.

The electric power plant was planned to supply the railroad with sufficient power to operate the line to Parkesburg, forty-five miles west, to which it was originally intended to build the railroad. Because of the heavy cost of constructing the first section it has been decided not to build further for some time. As a result, the greater part of the plant is useless, and the fixed charges on the first section of the railroad are in excess of receipts, it is said.

While it is not admitted, George R. Sheldon, president of the Philadelphia & Western Railroad, is said to be identified with the Equitable Electric Power Company. Other financial interests in the Equitable company are identified with the Keystone Telephone Company, of Philadelphia; Sheldon & Company and Mackay & Company, of New York. The telephone interests are represented by James Collins Jones, a vice-president, who is counsel for the lighting and power company and for Mr. Sheldon personally.

If the Equitable company obtains a franchise, either for lighting or furnishing electricity for commercial purposes, its plant can be put in operation very quickly. Feed wires from the Philadelphia & Western plant will be brought into the city over the company's right of way. It is known that the Equitable company has an option on a lease of the conduits of the Keystone Telephone Company. The latter company owns about 12,000,000 feet of vitrified tile ducts in 285 miles of streets.

Inasmuch as the Philadelphia & Western company operates under a steam-railroad charter, it is probable that its form of charter would not be amended because of its present value. To become associated in the lighting and power plan the company would probably enter into an agreement to sell its power for a long period, and, if necessary, to add to its power plant as the demand increased.

By entering into such an agreement the railroad company would have better opportunity to dispose of first-mortgage gold bonds amounting to $15,000,000 which it has in its treasury.

Generating Units for a New 1,200-Volt Direct-Current Railway System.

Operating electric railways with direct current transmitted at 1,200 volts pressure is, at the present time, of special interest owing to the absence of the high-tension wiring and the now familiar substations. The first road to operate its line on this plan, which is said to have proved entirely feasible, is the Indianapolis & Louisville Traction Company. This system is forty-one miles long, connecting Seymour, the southern terminus of the Indianapolis, Columbus & Southern Traction Company, with Sellersburg, the northern terminus of the Louisville & Northern Railway and Lighting Company. The power-house is located at Scottsburg, about the centre of the route. The feeding pressure at the power station is 1,200 volts between the single No. 0000 grooved trolley and the rails.

Two Allis-Chalmers engines of the well-known heavy-duty type, twenty-six by forty-eight-inch, operating non-condensing, at 120 revolutions per minute, drive, in pairs, four 300-kilowatt, 600-volt generators, with armatures mounted commutator to commutator on the engine shaft, the combined output being at 1,200 volts.

In addition to operating its cars at this pressure, the company maintains a line from Sellersburg to Louisville, a distance of fourteen miles, at 600 volts pressure; consequently cars are now being run successfully over sections of trolley fed with current both at 1,200 and 600 volts.

Current Electrical News

DOMESTIC AND EXPORT.

CLEVELAND STREET RAILWAY AGREEMENT—The Cleveland (Ohio) Electric Railway Company has accepted Mayor Tom L. Johnson's holding plan. The three-cent and five-cent roads will now be merged. The figure at which the Cleveland Electric stock shall be taken over has not yet been fixed.

PLANS FOR MEXICAN POWER PLANT COMPLETED—It is announced that all details in connection with the Monterey (Mexico) Hydroelectric Company have been completed. This concern was recently organized to establish hydroelectric plants near Montemorelos, state of Nuevo Leon, and generate power for use in Monterey. Bernard MacDonald is president of the company and M. E. MacDonald is secretary and treasurer. The water concessions under which the new company will operate were secured several years ago by Lilliendahl Brothers, of Saltillo, and cover the use of the water of the Pilon river for a considerable distance. Mr. MacDonald states that the hydraulic work will be started in January next, and that power will be delivered in Monterey within two years.

NEW ELECTRIC ROADS FOR COLORADO—With the intention of building an electric line between Denver and Colorado Springs, Col., and to make an electric road of the Denver & Intermountain from Denver to Golden, an enterprise that will cost $7,000,000, the Chase Improvement Company, representing Colorado and South Dakota capital, has filed articles of incorporation with the secretary of state. Charles H. Chase, of Clark county, South Dakota, is the chief stockholder, and Stephen B. Thomas, of Denver, and Daniel Prescott, of Littleton, are also heavily interested in the project. Mr. Thomas says that the movement has been under way for more than a year and that the company is in possession of right of way and franchises. The establishment of road-beds and power plants will begin as soon as the directors organize the company.

ELECTRIC BUS LINE FOR ST. LOUIS—The St. Louis Auto Exchange, capitalized at $30,000, has begun the operation of an electric bus line in St. Louis, Mo. Forty-six machines, representing an expenditure of $110,000, have been put into service. Hugo Koch and Charles J. Lewis are the principal promoters. Among the cars will be nine especially adapted to sight-seeing. The cars start from Union Station and four the city. Six of these cars carry eighteen passengers each and three will carry thirty each. Twelve of the cars are built for hotel service and will make trips only between the Union Station and the principal hotels. Six will be opera coaches and are to be chartered to theatre parties. There are six cabs to operate in the down-town district, and four broughams. The rest of the cars will be of the ordinary touring class.

ADDITIONAL ELECTRIC POWER FOR CHICAGO—The Chicago Sanitary District's new hydroelectric power-house, north of Joliet, has been placed in commission. The power, which has been created through a $4,000,000 investment on the part of the Sanitary District, will be delivered by means of aluminum cables to Chicago, the town of Cicero, the west park board, and the village of Morgan Park. These four contracts, however, will use only 10,000 of the 31,000 horse-power to be developed ultimately. The present capacity is 16,700 horse-power. With the plant taxed to its full capacity an annual income to the board of $500,000 will be assured. The cables are carried on steel towers sixty feet in height, which are set in concrete bases. Each of the six cables used is composed of nineteen strands of aluminum wire. The line is twenty-nine and one-half miles long.

PENNSYLVANIA TELEPHONE MERGER—The merger of the Bell Telephone Company of Philadelphia, the Pennsylvania Telephone Company, the Delaware & Atlantic company of Pennsylvania and the Chesapeake & Potomac company into the Bell company of Pennsylvania, with $60,000,000 capital stock, was practically completed on December 3, when stockholders of the Bell company of Philadelphia met and ratified the proposition. The board of directors will be increased from twelve to fifteen, and representatives of the merging companies will have places on the new board. Of the new company's $60,000,000 capital, about $42,000,000 will be issued now, of which $25,000,000 will be exchanged, share for share, for the outstanding stock of the Bell company of Philadelphia; $5,000,000 will be exchanged, share for share, for the outstanding Pennsylvania Telephone Company stock, and $12,000,000 will be used to acquire the Chesapeake & Potomac. The territory covered by the new company will include about 40,000 square miles. It will consist of Pennsylvania west to Altoona for over two-thirds of the state, the southern half of New Jersey and Delaware, Maryland, the District of Columbia and several counties in Virginia and West Virginia. The company will have over 300,000 telephones. Directors were elected as follows: U. N. Bethell, F. H. Bethell, C. J. Bell, Addison Candor, T. E. Cornish, R. M. Elliot, E. J. Hall, H. S. Huidekoper, J. E. Mitchell, Richard O'Brien, A. P. Perley, Francis B. Reeves, H. A. Richardson, A. R. Shellenberger and Theodore N. Vail. The new members of the board are: C. J. Bell, of Washington; Addison Candor, of Williamsport; Richard O'Brien, of Scranton; A. R. Shellenberger, of Harrisburg, and A. P. Perley, of Williamsport.

ANNUAL REPORT OF THE MASSACHUSETTS ELECTRIC COMPANIES—The eighth annual report of the Massachusetts Electric Companies, covering the year ended September 30, has been issued. The income account shows as follows: Gross earnings, $7,758,511; expenses, $5,000,652; net earnings, $2,757,858; charges, $1,702,622; balance, $1,055,235; dividends, $880,773, leaving a surplus of $174,462, comparing with $329,779 for 1906. The total surplus amounts to $1,566,884. President Abbott says in part: "The net results have been nearly identical with those of last year. There has been a certain amount of variation in the items—gross earnings increased $240,270, winter expenses were larger, cost of accidents was smaller—but the final result of all these variations is that net divisible income increased $15,050; or, in other words, remained substantially the same as last year. The freight and express business has shown a gratifying increase on those parts of the Old Colony where it has been put in operation, but it has not been possible even yet to secure all the necessary rights to carry freight over the whole of that system. With respect to the physical condition of the property, it has improved over that of last year. Liberal charges to operating expenses for maintenance have been supplemented by the expenditure of $1,574,680 for construction, reconstruction, and the purchase of additional rolling stock and other property. Whether or not it will be judicious to spend, during the coming year, the balance required to complete the reconstruction of the property will depend upon the general business situation, and the trustees do not intend to approve of any considerable new expenditures until that situation shall be clearer than it is at present." The above-mentioned expenditure of $1,574,680 during the year has been divided as follows: Track construction, $158,080; track reconstruction, $393,048; cars and electrical equipment, $555,645; wire and bonding, $42,568; power stations, $294,111; land and buildings, $111,150; sundries, $20,073; total, $1,574,680.

TELEPHONE AND TELEGRAPH.

KALAMAZOO, MICH.—The Home Telephone Company will establish an exchange at Kalamazoo.

TONOPAH, NEV.—The Nevada Consolidated Telephone and Telegraph Company has purchased all the rights, plant and equipment of the Pacific Telephone Company in this city.

NEW YORK, N. Y.—At the annual meeting of the stockholders of the Southern & Atlantic Telegraph Company, G. W. E. Atkins was elected a director. Other directors were reelected.

NORTH YAKIMA, WASH.—Changes and improvements in the telephone system at North Yakima, which have been under way during the last three months, have been completed, and the new system is in use.

WARDNER, IDA.—The North Fork Telephone Company has received a franchise to erect poles and string wires at Wardner. The route of the line will be along the North Fork and the Idaho Northern right of way.

PHILADELPHIA, PA.—The Keystone Telephone Company, of Philadelphia, reports gross earnings for four months, including October, of $349,160. The expenses and taxes amounted to $183,730, leaving net earnings of $165,430.

CLINTON, ILL.—A deal has been consummated resulting in a merger of the Central Union Telephone Company and the National Telephone and Electric Company. Under the new agreement subscribers to the latter company will have access to the long-distance service of the Central Union company.

PITTSBURG, PA.—At the annual meeting of the Johnstown Telephone Company, in Johnstown, January 20, the stockholders will be asked to vote an increase in the capital stock of the company from $600,000 to $1,000,000 for the purpose of making extensive improvements to the plant of the company.

EAU CLAIRE, WIS.—The Culbert Valley Telephone Company has been organized in the town of Seymour with the following officers: President and manager, J. J. Culbert; secretary and treasurer, A. L. Clark. Arrangements have been made with the Wisconsin Telephone Company to connect with the Eau Claire exchange.

CHESAW, WASH.—Chesaw and Molson parties have purchased the Pacific States Telephone Company's line between Chesaw and Molson, in Okanogan county, Wash. In the western part of the county the Government forest service is associating with the people in the construction of a telephone line from the county seat into the Methow Valley, in the Washington forest reserve.

CORTLAND, N. Y.—The Cortland Home Telephone Company, which for the past two years has existed practically in name only, no longer exists, as every share of preferred and common stock has been secured by the Empire State Telephone Company, one of the territorial divisions of the Bell Telephone Company. Practically all the preferred stock of the Home Telephone Company was acquired by the Bell company some two years ago, and the remaining stockholders have sold their shares to the Bell company at its original value. The common stock was taken in the first instance.

MOLINE, ILL.—A new franchise ordinance which will give the company permission to install an automatic exchange system in this city is to be sought by the Union Electric Telephone and Telegraph Company. The change from the present manual system to the automatic will necessitate complete overhauling of the plant and the installation of practically a new plant and new equipment throughout. Basing its claim on the benefits to be derived and the expenditure involved, the company will ask the council to relieve it of the franchise tax on its receipts, and to increase the maximum rate from $36 to $52 a year.

SPOKANE, WASH.—The working out of plans now under consideration means that Dayton, Wash., and the wheat belt in the Walla Walla district, southwest of Spokane, will be part of the system which the Independent Telephone Company is organizing throughout the Pacific Northwest. The movement is supported by the Dayton Commercial Club and many of the prominent business men of the city. J. E. McGillivray, a representative of the Independent interests, and W. J. Brownell will organize a stock company to install the plant, which will have connections with Walla Walla and the surrounding towns in the district.

NEW PUBLICATIONS.

"DISCUSSION OF PRESENT-DAY PROBLEMS"—This pamphlet has been published for the Empire State Gas and Electric Association and the Street Railway Association of the State of New York, and includes addresses made before a joint meeting of these organizations at Madison Square Garden, New York city, October 1. The addresses were as follows: "Relation of the Public Service Commission to Corporations," Hon. Frank W. Stevens, chairman Public Service Commission for the Second District, New York; "Electric Railway Situation of To-Day," by Henry J. Pierce, president of the International Railway Company, Buffalo, N. Y.; "Control of Gas Companies by State Commissions," by Alexander C. Humphreys, president Stevens Institute of Technology, Hoboken, N. J.; "Public Control from the Corporate Standpoint," by Everett W. Burdett.

ANNUAL REPORT OF THE SUPERINTENDENT OF LIBRARY AND NAVAL WAR RECORDS—The annual report of the superintendent of Library and Naval War Records to the secretary of the Navy, for the fiscal year 1907, has been published. Of Naval War Records, Vol. 21 has been distributed, Vol. 22 has been compiled and prepared for the printer, and Vols. 23, 24, 25 and 26 have been roughly compiled. These volumes include the operations of the Union and Confederate naval forces on the Mississippi river and tributaries. The general or final combined index has been begun, and a scheme of preparation adopted. The search for Confederate data has been continued by an agent authorized by Congress for that purpose. Progress has been made in the classification of books and revision of catalogues. The author-and-title card catalogue has been increased by the addition of cards for the books in assembled classes. The assembling of classes E (engineering), S (science), T (sociology), V (voyages), W (naval and military history), H (history, travel and adventure), has been completed. The number of volumes in the library acceded during the fiscal year was 801, including books and bound periodicals. The last accession number for the fiscal year 1907 was 40,143.

NEW INCORPORATIONS.

INDIANAPOLIS, IND.—The Modoc Telephone Company. Capital increased to $10,000.

COLUMBUS, OHIO—The Valley Power Company, Akron. $50,000. Incorporators: Harry A. Williams and others.

REDLANDS, CAL.—Southwestern Home Telephone Company, of Redlands. $100,000, of which $3,500 has been subscribed.

MILWAUKEE, WIS.—The Mineral Paint Electric Light Company. An amendment enlarging the scope of its business and increasing its capital from $25,000 to $50,000.

LOS ANGELES, CAL.—West Side Gas and Electric Company. $10,000, all subscribed. Directors: John W. Beardslee, Allen G. Carswell, C. Bamesberger, Sadie Carswell and Eva Hyatt.

NEW MANUFACTURING COMPANIES.

CHICAGO, ILL.—The Lounsbery Brothers Company has been incorporated with a capital of $10,000 to do an electrical business. The incorporators are: H. F. Lounsbery, F. L. Pratt and A. A. Lounsbery.

OAKLAND, ME.—The National Electrical Manufacturing Company has been incorporated with a capital of $100,000. The officers are: President, G. S. Jewett, Norridgewock; treasurer, V. C. Totman, Oakland.

SPRINGFIELD, ILL.—The Chicago Electric Equipment Company has been incorporated with a capital of $2,500 to do a manufacturing and contracting business. The incorporators are: William K. Yath, H. I. Keck, John W. Clark.

EDUCATIONAL NOTE.

WINONA TECHNICAL INSTITUTE—The Winona Technical Institute, of Indianapolis, Ind., offers two electrical courses, in which particular attention to the practical side of the work is given. One course is on wiring and maintenance, and covers a year's work of fifty-five weeks. The second course is in electrical engineering, and covers two years' work of fifty-five weeks each. The faculty consists of Professor R. M. Murray, dean of engineering; Professor Satterfield, director of electrical department; Professor G. W. Dinkel, Jr., department of applied electricity; Professor J. H. Gertler, department of chemistry.

PERSONAL MENTION.

MR. LEROY P. SAWYER, manager of the Buckeye Electric Company, married Miss Jessamine A. Pike, a well-known vocalist of Cleveland, Ohio, on December 4. Mr. and Mrs. Sawyer are taking an extended trip throughout the South.

MR. THOMAS J. LAWTON, who has been connected with the construction department of the Southern New England Telephone Company for a number of years, has tendered his resignation, and will hereafter be located in New York city. The construction department of the New England company gave Mr. Lawton a farewell dinner on the eve of his departure.

MR. H. J. PETTENGILL, due to ill-health, retired on December 1 from the presidency of the Northwestern Telephone Exchange Company, which embraces, among others, the Northwestern Telephone Company, the Minnesota Central Telephone Company, the Duluth Telephone Company, Missabe Telephone Company and the Douglas County Telephone Company. Mr. Pettengill will devote himself to the Southwestern Telegraph and Telephone Company, operating in Texas and Arkansas, of which company he is also the head. A farewell banquet was tendered Mr. Pettengill on the evening of November 30, at the Minneapolis Club, by Vice-President C. P. Wainman, of the Northwestern company, when a loving cup was presented to him on behalf of the company's officials.

OBITUARY NOTES.

MR. H. C. BONNEY, traveling auditor of the American Telephone and Telegraph Company, died of heart failure at the home of his daughter in Malden, Mass., on November 16. He had been in the employ of the company for twenty-nine years.

MR. MORRIS F. TYLER, president of the Southern New England Telephone Company and formerly treasurer of Yale University, died suddenly on December 4 in New Haven, Ct. Mr. Tyler had been ill only three days, but had been in failing health for two years. Death was caused by a stroke of apoplexy. Mr. Morris Frank Tyler was born in New Haven in 1848. His father, Morris Tyler, was at one time lieutenant-governor of Connecticut. He was graduated from Yale in the class of '70 and from the Yale law school in '73. He was executive secretary for Governor Bigelow, of Connecticut, in 1881 and was professor of law at Yale from 1893 to 1899, when he was elected treasurer of the university. In 1873 he married Delia Audubon, daughter of Victor Gifford Audubon, the naturalist. Four sons survive him—Victor Morris Tyler, secretary of the Southern New England Telephone Company; Ernest Franklin Tyler, an artist in New York city, and Leonard Sanford Tyler and Audubon Tyler, of New Haven.

MR. CHARLES PHILO MATTHEWS, professor of electrical engineering at Purdue University, died at Phoenix, Ariz., on Saturday, November 23. Professor Matthews was of Vermont stock, his family going from that state to New York in 1852 where, at Fort Covington, he was born September 18, 1867. At the time of his death he was, therefore, a little more than forty years of age. He attended the St. Johnsbury Academy, at St. Johnsbury, Vt., graduating from there in 1887. He then entered Cornell University, graduating from Sibley College with the degree of Mechanical Engineer in 1892. In 1901 he received the degree of Doctor of Philosophy from his Alma Mater. Immediately after graduation he became instructor in physics and applied electricity at Cornell, serving in that capacity four years, until 1896. At that time he was called to Purdue and was appointed associate professor of electrical engineering. In 1905 he succeeded Professor W. E. Goldsborough as head of the school of electrical engineering, and from this time until his death he was continuously a member of the Purdue faculty. During Professor Matthews' connection with the school of electrical engineering it has grown to be the largest in the country in point of numbers. In this development he has had a large share. His instruction was of the highest order, not only on account of his professional ability and training, but quite as much on account of his exceptional personality and gifts. He made valuable contributions to his science, his chief work being an investigation of photometric standards for arc lamps. This was done in connection with the National Electric Light Association. He directed all of the experimental work, designed the apparatus and prepared four reports, aggregating about two hundred pages. In this connection he devised and patented an integrating photometer. This instrument received a gold medal at the Louisiana Purchase Exposition. He was also collaborator in the production of text-books of physics and electricity with Professors Nichols and Shearer, of Cornell, and with Professor Esterline, of Purdue, and had published a number of papers on electrical subjects. He was a member of the honor fraternity, Sigma Xi. Professor Matthews was buried on November 25 at Fort Covington, N. Y.

ELECTRICAL SECURITIES.

A noticeable improvement in the stock market was evident last week, the recovery being continued. The upward movement, while irregular, was general, and substantial gains were made. The buying was mainly professional, the public apparently not yet having recovered from the shock of recent developments. Slow but steady improvement has been made in the monetary situation. Moderate gold imports were made, bringing the total imports engaged to date to $97,000,000. It is the general opinion, however, that the gold movement has ended. The bank statement for the week showed a reduction in the deficit to $46,210,350, reflecting the improved monetary conditions.

Dividends have been declared upon the following electrical securities: Indianapolis (Ind.) Street Railway Company: a regular dividend of 3 per cent on the common stock, payable January 1. Portland (Ore.) Railway, Light and Power Company: the regular quarterly dividend of 1¼ per cent on the preferred stock, payable January 2 to stockholders of record at the close of business December 14.

ELECTRICAL SECURITIES FOR THE WEEK ENDING DECEMBER 7.

New York:	*Closing.*
Allis-Chalmers common	6⅜
Allis-Chalmers preferred	16¼
Brooklyn Rapid Transit	40¼
Consolidated Gas	92
General Electric	114
Interborough-Metropolitan common	8
Interborough-Metropolitan preferred	20½
Kings County Electric	80
Mackay Companies (Postal Telegraph and Cables) common	53
Mackay Companies (Postal Telegraph and Cables) preferred	58
Manhattan Elevated	115
Metropolitan Street Railway	27
New York & New Jersey Telephone	96
Western Union	60
Westinghouse Manufacturing Company	46¼

Directors of the Interborough Rapid Transit Company have declared the regular quarterly dividend of 2¼ per cent on the capital stock, payable January 2 to holders of stock and voting trust certificates of record December 16. Books close December 16 and reopen January 2.

Boston:	*Closing.*
American Telephone and Telegraph	103½
Edison Electric Illuminating	200
Massachusetts Electric	—
New England Telephone	105
Western Telephone and Telegraph preferred	52

Philadelphia:	*Closing.*
Electric Company of America	8¾
Electric Storage Battery common	33½
Electric Storage Battery preferred	33½
Philadelphia Electric (ex dividend)	6¾
Philadelphia Rapid Transit	17½
United Gas Improvement	73¾

Chicago:	*Closing.*
Chicago Telephone	108¾
Commonwealth-Edison	79½
Metropolitan Elevated preferred	46
National Carbon common	55
National Carbon preferred	100½

The Chicago Telephone Company has declared the regular quarterly dividend of 2½ per cent payable December 31 to holders of record December 23. During November the Chicago Telephone Company gained 1,462 subscribers. The total telephones now in use number 200,665.

The daily average of passengers carried during November by the South Side Elevated was 120,594, an increase of 26,313; Northwestern Elevated, 106,847, an increase of 13,609; Metropolitan Elevated, 151,518, a decrease of 953; Chicago & Oak Park Elevated, daily average of passengers, including transfers, for November, 49,128, a decrease of 2,254.

ELECTRIC LIGHTING.

CHICO, CAL.—L. D. Macy has been granted an electric lighting franchise by the city council.

NEW HAVEN, MICH.—A ten-year street-lighting contract has been entered into with the St. Clair Edison Company.

BERKELEY, CAL.—C. S. S. Forney has made application for permission to install a new lighting system in Berkeley.

NEWBURGH, N. Y.—The Newburgh Light, Heat and Power Company has extended its service to the town of Milton.

SHERBURN, MINN.—The municipal electric-light-plant proposition failed to carry at an election held to decide the question.

PORTLAND, ORE.—The council has authorized the renewal for five years of the city's contract with the Portland Electric Light and Power Company.

HARVEY, N. D.—The secretary of the Commercial Club of Harvey will be glad to hear from parties desiring to install and operate an electric light plant.

ROCKFORD, ILL.—The Rockford Edison Company has changed its name to the Rockford Electric Company, and increased its capital stock from $350,000 to $1,000,000.

TOPPENISH, WASH.—Everett Bohannon, who was recently granted an electric light franchise, has ordered the necessary material and will start work as soon as possible.

HAZLETON, PA.—The Harwood Power Company, which is furnishing current to the Consumers' company, is extending its wires to Lattimer. The service will be installed there in a few weeks.

YORK, PA.—At a meeting of the Merchants' Electric Light, Heat and Power Company it was decided to double the capacity of the present plant by the purchase of a 750-kilowatt steam turbine.

CLINTON, OKLA.—The city council has granted an electric light and power franchise to F. Murch, of Hennessey, Okla., and contracted for twenty street lights. Work on the system will commence at once.

SYRACUSE, N. Y.—A substation for Niagara power is being built by the Syracuse Lighting Company, at Solvay. The necessary apparatus has been ordered, and it is expected that the city will be illuminated by power from Niagara next April or May.

ALLENTOWN, PA.—At a meeting of the citizens of McAdoo, Luzerne county, it was unanimously decided to sell or lease the borough electric light plant, the operation of which has proved a financial failure. Municipal ownership of the street-lighting facilities was one of the first principles carried out when McAdoo was incorporated, and for a time the plant paid.

GOUVERNEUR, N. Y.—A project for utilizing the power from the falls at Sawyers Gorge, about two miles from this village, is being considered. The falls are situated on Sawyers creek. They are nearly forty feet in height and will give an abundance of power for the transmission of electricity to this village. It is the intention of the promoters, if the scheme goes through, to ask the village board for a franchise.

SALT LAKE CITY, UTAH—The Utah Light and Railway Company has submitted a proposition for street lighting. This is practically as follows: The installation of 700 arc lamps of a new pattern at $72 each per year; total cost, $50,400. Four hundred incandescent boulevard lights at $25 each per year; total cost, $10,000. Total cost per year for lighting the city, $60,400. The present cost is $36,000, and this includes, all told, only 574 lights, of which about 450 are arcs of the old variety.

SYRACUSE, N. Y.—Because the financial situation renders it inexpedient for the Syracuse Lighting Company to make an investment of $117,000 upon its system at this time, as is required by the provisions of the Hammond act before it may enter into a contract with the city of Syracuse for street lighting, no such contract will be made. The outcome of the conference was that the Syracuse Lighting Company should make such improvements to its system as it could without involving any large expenditure, with the understanding that the city is to continue to pay for its lighting service at the present rate of $68 per annum per arc lamp as laid down by the order of the former state gas and electricity commission.

ELECTRIC RAILWAYS.

MANCHESTER, N. H.—The new electric line between Manchester and Derry has been completed. It is eight miles in length.

PHILADELPHIA, PA.—The Green Lane town council has granted a franchise to the Perkiomen Valley Traction Company for a line from Green Lane to Collegeville.

THERMOPOLIS, WYO.—The Thermopolis-Hot Springs Electric Railway Company has ordered cars and supplies and expects to have the first electric railway in Wyoming in operation by February 1.

CANON CITY, COL.—Work has been resumed on the Canon City & Royal Gorge Electric line and will be pushed until the line is completed. The franchises cover about twenty-seven miles of trackage, which will cost $250,000.

AKRON, OHIO—Thomas T. Childs and others have made application for the incorporation of the Akron & Youngstown Electric Railway Company, with $100,000 capitalization. Work is to begin at North Jackson within thirty days, and the road is to be an air-line between Youngstown and Akron, and the final link between Cleveland and Pittsburg.

AUGUSTA, GA.—Negotiations are being perfected for the Atlanta & Carolina Electric Railway Company, of Atlanta to secure an old survey of the Seaboard Air Line between Augusta and Athens, for an electric line from Atlanta to Augusta. The contract for the construction of the entire line from Augusta to Atlanta has been let to an Atlanta firm.

LIMA, OHIO—The Lima & Toledo Traction Company announces the opening of its line north as far as Deshler, touching Bellmore. The line has been in operation north as far as Leipsic for some weeks and is completed as far as the Lucas county line, with franchises in the city of Toledo already acquired. The road will cross the Maumee at Waterville, where a reinforced concrete bridge is now in course of construction. Contractors have begun laying the rails in the connecting link between this city and Bellefontaine, and a portion of the line is to be opened for service out of Bellefontaine within sixty days. Permanent pressed brick stations will be erected in all villages.

NORTH YAKIMA, WASH.—The Yakima Valley Transportation Company has decided to begin construction work in the Moxee Valley as soon as its construction work west of town is completed. The transportation company claims to have prior rights through the Moxee Valley, through which the Hanford survey also will run, and the local company is anxious to get into the field at once. James Barnes, local representative of the Hanford Irrigation and Power Company, announced some time ago that a survey was being made by his company for an electric line to this city. The Yakima Valley Transportation Company already has its survey through the Moxee Valley completed.

MONONGAHELA, PA.—The application of the Monongahela & Carroll Street Railway Company to build a street railway in Monongahela has been approved. The capital stock is placed at $12,000, which is nominal, and the names of the directors are given as follows: E. B. Hartman, Jr., W. D. McBryar, E. W. Marshall, W. S. Walsh and W. E. Walsh, all of Pittsburg. According to the terms of the ordinance the company is to post a bond in the sum of $5,000 with the city, within thirty days from the date of the granting of the charter, binding it to begin operations on the road and complete the same, ready to operate, within two years. It is the object of the company to continue the line up Pigeon creek to Bentleyville, and thence to Washington.

VANCOUVER, B. C.—The British Columbia Electric Railway Company has bought a charter empowering the building of an electric railway between Vancouver and the international boundary line, at or in the vicinity of Blaine. The company has secured an option on the Lillooet river power plant, the water rights for which were secured two years ago by Hermon & Burwell, engineers and surveyors, of Vancouver. The charter purchased is a Dominion one, and gives authority for building to the boundary as well as the construction of a branch line to Chilliwack. No rights to the south of the boundary line were secured in connection with the purchase of the charter in British Columbia, though the former owners of the charter had an understanding with James A. Moore, of Seattle, that when the road was built it would be met at the boundary by a road built under a Washington state charter by Moore and associates.

INDUSTRIAL ITEMS.

THE CHARLES E. DUSTIN COMPANY, 11 Broadway, New York city, has issued a new catalogue of electrical and steam machinery for central stations, street railways and isolated plants.

THE LOWE ELECTRIC COMPANY, 54 Vesey street, New York city, has ready for distribution some interesting literature devoted to "Conqueror" electric lighting outfits for Christmas-tree decoration.

THE BLAKE SIGNAL AND MANUFACTURING COMPANY, 246 Summer street, Boston, Mass., announces that it has appointed James Goldmark, 83 Warren street, New York city, agent for its specialties.

THE WILE POWER GAS COMPANY, manufacturer and engineer of producer-gas installations for power and fuel, announces the removal of its general offices from the Cutler Building, Rochester, N. Y., to 1688-1692 Columbus Road, Cleveland, Ohio.

THE COOK STANDARD TOOLS COMPANY, Kalamazoo, Mich., has published a very interesting catalogue devoted to modern methods of maintenance. This company is the manufacturer of track drills, track tool grinders, car jacks, track jacks, cattle guards, etc.

THE TRUMBULL ELECTRIC MANUFACTURING COMPANY, Plainville, Ct., in "Trumbull Cheer" for December, calls attention to its combination switches and iron boxes with or without combination switches. There is also considerable interesting matter containing several happy holiday suggestions.

THE CHICAGO FUSE WIRE AND MANUFACTURING COMPANY, 170 South Clinton street, Chicago, Ill., has published a new catalogue, No. 21, devoted to "Union" switch boxes. These boxes are made in sectional form, and it is easy to assemble a switch box for either metallic conduit or flexible conduit, with as many outlet holes as may be necessary for the work in hand.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., in bulletin No. 4,352, describes and illustrates type D direct-current instruments. These instruments are constructed upon the well-known D'Arsonval principle, and are designed for switchboard use. The bulletin gives dimension diagrams of instruments and shunts, full-size views of the scales, and data regarding catalogue numbers, capacities, prices, etc.

THE SANGAMO ELECTRIC COMPANY, Springfield, Ill., has ready for distribution a new bulletin describing the Sangamo regular and switchboard type meters. The company has also issued a pamphlet entitled "About Sangamo Wattmeters," which has been prepared for the purpose of giving comprehensive information with regard to Sangamo meters and meters in general. Copies of these publications will be sent to engineers upon request.

THE NATIONAL BATTERY COMPANY, Buffalo, N. Y., announces that, owing to its daily increasing business, it has taken possession of the entire building at 236 West Fifty-fourth street, New York city, one door west of Broadway. This contains a great deal more floor space than the present office and depot. The company will be fully equipped to handle everything pertaining to battery requirements of automobile manufacturers, dealers and owners.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., in the December issue of "Graphite," devotes considerable space to matter commemorative of the Atlantic City convention of the American Street and Interurban Railway Association. There are several fine illustrations of the company's exhibit, and typical views of Atlantic City's prominent places. There are also reproductions of the sand figures, which attracted a great deal of attention at the recent convention.

THE MANHATTAN ELECTRICAL SUPPLY COMPANY, 17 Park Place, New York city, has published some very interesting literature containing a great many practical suggestions for the holidays. Among the electrical specialties for the holidays which this company announces are Christmas-tree lamp outfits, electric engines, medical apparatus, massage vibrators, alarm clocks, learners' telegraph instruments, vest-pocket electric flash-lights, private line telephones, electric irons, hot-water heaters, portable desk lamps and call-bell outfits.

THE BRISTOL COMPANY, Waterbury, Ct., is distributing three new bulletins covering Bristol electrical instruments. Bulletin No. 61 describes recording voltmeters, and contains twelve pages. Bulletin No. 62 describes recording ammeters, and includes a description of a new form of portable instrument which is now being made by the company, and which is stated to be a very attractive piece of apparatus. Bulletin No. 63 is devoted to a line of recording wattmeters, and is somewhat larger than the others, containing nineteen pages. This bulletin, besides illustrating a new portable form of wattmeter, also shows a complete line of single, two-phase and balanced three-phase, alternating-current instruments. These bulletins will be sent to engineers upon request.

THE H. B. CAMP COMPANY, 170 Broadway, New York city, has got out a striking pen-and-ink drawing illustrating the revolution in campaign methods which has been brought about by the telephone. This is entitled "From Waterloo to Mukden," and shows a Japanese general, with his aides, conducting a battle by means of a field telephone that puts him in instant communication with all points of the field. In the background is the phantom of a military courier, such as were the main dependence for transmitting orders and reports at the time of Waterloo. The Camp company has also issued recently an interesting circular describing the various types of clay conduits for electric wires which it manufactures. Further details may be obtained by writing to any office of the company.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., in bulletin No. 1608, describes single-stage motor-driven centrifugal pumps for any capacity and condition of service within the range of their adaptability. Although the construction of these pumps is said to be the simplest yet devised, in order to secure maximum efficiency the design is carefully worked out to meet the requirements of the service for which each is intended. They are valveless and operate with very little vibration, rendering them useful for many kinds of service where pumps of other types cause considerable annoyance and expense. These machines are adapted for use as circulating pumps for cooling systems, surface or barometric condensers; for hot-water heating; for mine service; for industrial plants requiring the rapid circulation of large quantities of water, such as paper mills, tanneries, etc., or for operations that necessitate its ejectment, as in drydock work, dredging, etc., and when water and ment, as in drydock work, dredging, etc.; and when water and material, gritty substances and the like, as they are apt to be under the conditions mentioned, such pumps offer an easy solution of the problem. The company will be pleased to send the bulletin to any one interested, upon request.

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(Published in the Second Issue of Each Month.)

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STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, J. H. Pardee, J. G. White & Company, New York, N. Y.

TEXAS INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Charles F. Speed, Texarkana, Tex.

UNDERWRITERS' NATIONAL ELECTRIC ASSOCIATION. Secretary Electrical Committee, C. M. Goddard, 55 Kilby street, Boston, Mass.

VERMONT AND NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary-treasurer, G. W. Buzzell, St. Johnsbury, Vt.

VERMONT ELECTRICAL ASSOCIATION. Secretary, C. C. Wells, Middlebury Electric Light Company, Middlebury, Vt.

VIRGINIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, B. L. Fisher, Rocky Mount, Va.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 382 Ohio street, Chicago, Ill.

WESTERN SOCIETY OF ENGINEERS (Electrical Section). Secretary, J. H. Warder, 1737 Monadnock Block, Chicago, Ill.

WISCONSIN ELECTRIC AND INTERURBAN RAILWAY ASSOCIATION. Secretary, Clement C. Smith, president Columbia Construction Company, Milwaukee, Wis.

WISCONSIN INDEPENDENT TELEPHONE ASSOCIATION. Secretary, J. C. Crowley, Jr., Superior, Wis.

DATES AHEAD.

South Dakota Independent Telephone Association. Mitchell, S. D., January 8-9, 1908.

Chicago Electrical Show. Coliseum, Chicago, January 13-25, 1908.

International Independent Telephone Association. Annual meeting, Chicago, Ill., January 21, 22 and 23, 1908.

Nebraska Independent Telephone Association. Next meeting, Omaha, Neb., January, 1908.

Wisconsin Electrical Contractors' Association. Next meeting, Milwaukee, Wis., January 15, 1908.

Ohio Independent Telephone Association. Next meeting, Columbus, Ohio, March 19, 1908.

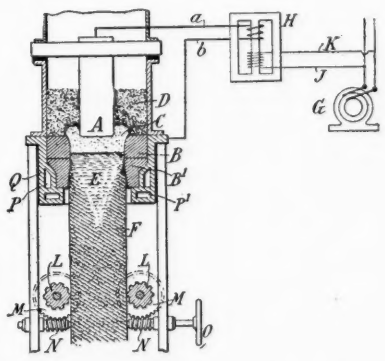
Record of Electrical Patents.

Week of December 3.

872,324. MAGNETIC WEDGE. Sven R. Bergman, Lynn, Mass., assignor to General Electric Company. A wedge of insulated iron wires for closing machine slots.

872,329. CONTROLLER. Arthur T. Crocker, Schenectady, N. Y., assignor to General Electric Company. A locking controller.

872,349. MOTOR-CONTROLLING SYSTEM. John D. Ihlder, New York, N. Y., assignor to Otis Elevator Company, Jersey City, N. J. A controller with a pair of reversing switches and electromagnetic means for locking them.



872,351.—MANUFACTURE OF CALCIUM CARBIDE, ETC.

872,351. MANUFACTURE OF CALCIUM CARBIDE, ETC. Jesse C. King, St. Catharines, Ontario, Canada, assignor to the Willson Carbide Works Company of St. Catharines, Limited, St. Catharines, Canada. The fused carbide is discharged through a die as it solidifies.

872,352. ELECTRIC FURNACE. Jesse C. King, St. Catharines, Ontario, Canada, assignor to the Willson Carbide Works Company of St. Catharines, Limited, St. Catharines, Canada. The material to be treated is fed in continuously at the top of the furnace and drawn out in solid form from the bottom.

872,356. MOTOR-DRIVEN BOAT. Hermann Lemp, Lynn, Mass., assignor to General Electric Company. The connection between engine and propellers is controlled by magnetic clutches.

872,409. ELECTROMAGNETICALLY OPERATED MECHANISM. Johan M. Andersen, Boston, Mass., assignor to Albert & J. M. Anderson Manufacturing Company, Boston, Mass. An electromagnetic locking device for an electromagnetic mechanism.

872,430. ELECTRIC ALARM. Frederick I. Johnson, Barrington, R. I. A time-alarm system.

872,432. ELECTRICAL APPARATUS. Charles J. Klein, New York, N. Y., assignor to Ralph Abraham Schoenberg, New York, N. Y. A casing for flush mounting of push switches.

872,436. LIQUID METER. John W. Ledoux, Swarthmore, and Norman Z. Ball, Philadelphia, Pa., assignors to Simplex Valve and Meter Company, Camden, N. J. The flow through the meter is recorded electrically.

872,474. ELECTRICAL MEASURING INSTRUMENT. William E. Sumpner, Birmingham, England. A phase indicator.

872,503. MAGNETIC IGNITER. Charles E. Duryea, Reading, Pa. A make and break igniter.

872,513. OIL-SWITCH. Edward M. Hewlett, Schenectady, N. Y., assignor to General Electric Company. A two-position oil-switch.

872,515. AUTOMATIC MOTOR-CONTROL APPARATUS. George H. Hill, Schenectady, N. Y., assignor to General Electric Company. A device for controlling the operation of a motor controller.

872,530. METHOD OF SEALING METAL IN GLASS. George H. Meeker, Media, Pa. An oxidizable metal is sealed in by pressing the plastic glass around the metal, thus expelling the air, and reheating to close the joint.

872,535. FREQUENCY CHANGER. Jakob E. Noeggerath, Schenectady, N. Y., assignor to General Electric Company. A combination of two rotary converters.

872,549. CURRENT CONVERTER. Leonard Wilson, Schenectady, N. Y., assignor to General Electric Company. An inverted rotary and an alternating-current generator mechanically coupled.

872,550. INDUCTION MOTOR. Ernst F. W. Alexanderson, Schenectady, N. Y., assignor to General Electric Company. An induction motor with a variable number of poles.

872,559. ALTERNATING-CURRENT MOTOR. Friedrich Eichberg, Berlin, Germany, assignor to General Electric Company. A commutator motor started by short circuiting the armature.

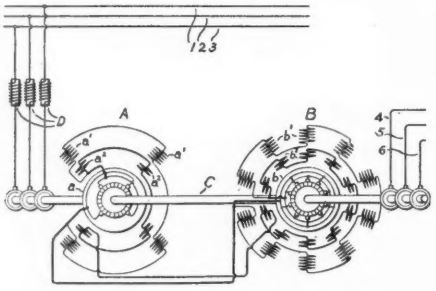
872,563. CONTROL SYSTEM. George H. Hill, Schenectady, N. Y., assignor to General Electric Company. A multiple-switch controller.

872,569. SYSTEM OF INSULATION FOR HIGH-VOLTAGE ELECTRIC CONDUCTORS. Fred M. Locke, Victor, N. Y. A series of co-axial insulators nested together.

872,570. RAILWAY SWITCHING AND SIGNALING APPARATUS. William Macomber, Buffalo, N. Y., assignor to General Railway Signal Company, Buffalo, N. Y. A system of motor-operated track switches.

872,572. ELECTRIC-METER CASE AND SUPPORT. Thomas E. Murray, New York, N. Y. A method of mounting meter cases.

872,581. ALARM APPARATUS. Lawrence W. Pennington, Worcester, Mass. An electric alarm for gas burners.



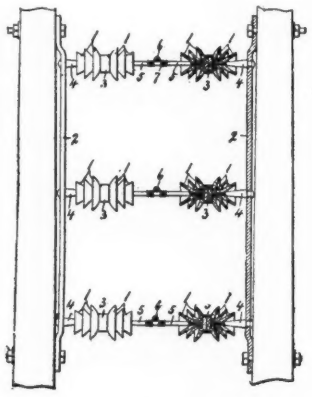
872,535.—Frequency Changer.

872,593. HYGROMETER. George L. Warnken, Jamestown, Cal., assignor to Warnken, Congdon, Coffer Company, Jamestown, Cal. An electrically controlled hygrometer.

872,613. RAILWAY SIGNALING APPARATUS. Frank L. Dodgson, and Winthrop K. Howe, Buffalo, N. Y., assignors to General Railway Signal Company, Buffalo, N. Y. A combined brake and signaling system.

872,628. TELEPHONE PAY STATION. George A. Long, Hartford, Ct., assignor to the Gray Telephone Pay Station Company, Hartford, Ct. A pay station for automatic telephones.

872,656. ELECTRICALLY HEATED CAN-CAPPING MACHINE. Montgomery H. Johnson, Utica, N. Y. An electrical soldering device.



872,569.—System of Insulation for High Voltage Electric Conductors.

872,670. METERING PANEL-BOARD. Arthur C. McWilliams, Chicago, Ill. A panel-board providing connections for meters.

872,680. AUTOMATIC RELEASER FOR FIRE-DOORS, FIRE-SHUTTERS, ETC. Henry J. Podlesák, Chicago, Ill. A magnetic door releaser.

872,684. MOTOR-CONTROL SYSTEM. Walter J. Richards, Norwood, Ohio, assignor to Allis-Chalmers Company. A rheostatic controller.

872,708. INDUCTION MOTOR. Bernard A. Behrend, Norwood, Ohio, assignor to Allis-Chalmers Company, and the Bullock Electric Manufacturing Company. Fan blades, integral with the rotor rings, engage with the end laminæ of the core.

872,720. CONTROLLER-OPERATING MECHANISM. Carl Fleming, Norwood, Ohio, assignor to Allis-Chalmers Company, and the Bullock Electric Manufacturing Company. An automatically released controller.

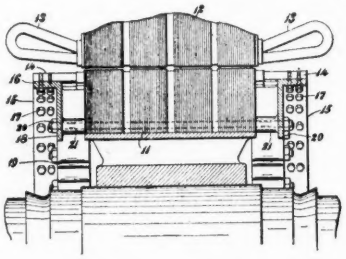
872,724. SYSTEM OF DISTRIBUTION. Edward M. Gerry, Norwood, Ohio, assignor to the Bullock Electric Manufacturing Company. The power-factor of the system is controlled by a synchronous motor.

872,756. INSULATOR. Frederick C. Scherer and Henry C. Fashbaugh, Columbiana, Ohio. A double-slotted insulator.

872,759. ELECTROLYTIC SHIP-BOTTOM PROTECTOR. John H. Schoneberger and George W. Frazier, Allegheny, Pa., assignors to Pittsburg Electrolytic Manufacturing Company. Means for passing a current between the ship's bottom and an insulated electrode.

872,802. TROLLEY. Gustav Ehmann, Canton, Ohio. The harp has a slight longitudinal movement.

872,824. ELECTRIC TELEGRAPHY. Isidor Kitsee, Philadelphia, Pa., assignor of one-half to William J. Latta, Philadelphia, Pa. A system employing two lines and two polarized relays.



872,708.—Induction Motor.

872,829. ELECTRIC CIRCUIT CONTROLLER. Harry W. Leonard, Bronxville, N. Y. An automatic release for rheostats.

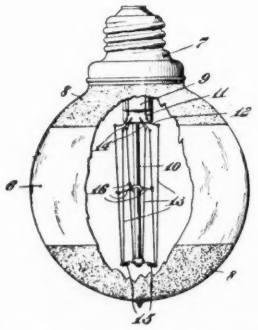
872,832. TELEPHONE-BOX HANGER. John G. Malaby and Charles E. Oxford, Foreman, Ark.; said Malaby assignor to said Oxford. A wire screw hook.

872,843. SEMAPHORE SAFETY-ALARM. George L. Pettygrove, Berkeley, Cal., assignor of one-half to C. E. Loofbourrow, Oakland, Cal. The removal of a train order automatically sets the semaphore.

872,878. ELECTRODE. Robert J. Wisnom, Virginia City, Nev. A metallic oxide electrode.

872,898. TROLLEY HARP. James L. Chase, Ayer, Mass., assignor of one-half to Ralph J. Joslin, Webster, Mass. The halves of the harp are hinged.

872,936. TUNGSTEN ELECTRIC INCANDESCENT LAMP. John A Heany, York, Pa. The filament is hung in loops from an insulating support.



872,936.—Tungsten Electric Incandescent Lamp.

872,938. SYSTEM OF CONTROL. George H. Hill, Schenectady, N. Y., assignor to General Electric Company. A control system for a number of motors.

872,939. SYSTEM OF MOTOR CONTROL. George H. Hill, Schenectady, N. Y., assignor to General Electric Company. A speed and direction controlling device.

872,985. ART OF PRODUCING ALUMINUM AND OTHER METALS. Henry S. Blackmore, Mount Vernon, N. Y. A substance containing aluminum is electrolyzed by means of a carbide electrode.

872,986. ELEVATOR. John W. Brown, East Sheen, England. An hydraulic ram, actuated by a motor-driven pump.

872,993. INSULATOR. Arthur S. Deem, Reading, Pa., assignor of one-half to Isaac Bear, Reading, Pa. An insulating cleat.